The Engineer

LONDON, FRIDAY, AUGUST 1, 1941.

PUBLIC NOTICES

COUNTY BOROUGH OF SOUTHPORT

GAS DEPARTMENT

The Gas Committee Invite TENDERS for the SUPPLY and DELIVERY to the Gasworks, Blowick, Southport, of an ELECTRICALLY DRIVEN VERTICAL SPINDLE SUMP PUMP, complete with Starter and Float Switchgear, and capable of delivering 20,000 gallons of water per hour.

Full particulars of requirements may be obtained on application to Jno. L. Anderson, Acting Gas Engineer and Manager, 91, Eastbank Street, Southport.

Tenders, stating period required for delivery, to be addressed to the undersigned in plain, sealed envelope, endorsed "Pump," so as to arrive not later than the first post on Tuesday, the 12th August, 1941.

The Council do not bind themselves to accept the lowest or any Tender.

R. EDGAR PERRINS, LL.M.,
Town Clerk.

Town Hall,
Southport,
23rd July, 1941. 7645

MANCHESTER SHIP CANAL COMPANY

APPOINTMENT OF ASSISTANT TO CHIEF ENGINEER

Applications are Invited for the POSITION of ASSISTANT to the CHIEF ENGINEER, at a commencing salary of £1000 per annum.

Candidates should not exceed 45 years of age, must be Corporate Members of the Institution of Civil Engineers, and be experienced in the Design, Construction, and Maintenance of Dock and Harbour Works.

Applications, stating age, qualifications, and previous experience, should be addressed to the GENERAL MANAGER, MANCHESTER SHIP CANAL COMPANY, SHIP CANAL HOUSE, MANCHESTER, 2, not later than August 25th, 1941. Envelopes to be marked "Personal."

Testimonials need not accompany applications. 7652

UNIVERSITY COLLEGE OF SWANSEA

(A CONSTITUENT COLLEGE OF THE UNIVERSITY OF WALES.)

Principal: C. A. EDWARDS, D.Sc., F.R.S.

APPLIED SCIENCE DEPARTMENTS
ENGINEERING

Professor: Frederic Bacon, M.A. (Cantab.), A.M. Inst. C.E., M.I. Mech. E., M.I.E.E.
Lecturer in Electrical Engineering: R. G. Isaacs, M.Sc. (Bristol), B.Sc. (Lond.), A.M.I.E.E.
Lecturer in Civil Engineering: A. A. Fordham, Ph.D. (Lond.), A.M. Inst. C.E., M.I. Struct. E.
Lecturer: J. Selwyn Caswell, M.Sc. (Wales), A.M.I. Mech. E., A.M. Inst. C.E.
Assistant Lecturer: W. E. J. Farvis, B.Sc. (Bristol).

METALLURGY

Professor: C. A. Edwards, D.Sc. (Manchester), F.R.S.
Assistant Professor: R. Higgins, Ph.D. (Glasgow).
Lecturer: R. Griffiths, M.Sc. (Wales).
Assistant Lecturer: T. B. Wilkinson, Ph.D., B.Eng. (Liverpool).

The College offers a number of exceptional advantages to students who aim at entering upon professional careers in Engineering or in Metallurgy. It is situated in the heart of an industrial area, which includes a large number of works of very varied character, and presents an unrivalled variety of metallurgical practice. The manufacturers of the district, who contribute largely to the support of the College, give the Staff and Students of the Applied Science Departments every access to the works, and the Managers, Engineers and Technical Officials co-operate with the Staff of the College in making visits to works of practical educational value to the Students.

Courses of study are provided (1) for the B.Sc. Degree of the University of Wales in (A) Civil Engineering, (B) Mechanical Engineering, (C) Electrical Engineering, (D) Metallurgical Engineering, (E) Metallurgy; and (2) for Diplomas of the College in (A) Civil Engineering, (B) Mechanical Engineering, (C) Electrical Engineering, (D) Metallurgy.

Persons who are not desirous of studying for Degrees or Diplomas may attend selected College Classes, provided they satisfy the authorities of the College that they are qualified to benefit by such Classes.

Entrance Scholarships will be offered for competition in April, 1942.

Particulars concerning admission to the College, and of the Entrance Scholarships, may be obtained from the undersigned.

EDWIN DREW,
Registrar.

Singleton Park,
Swansea. 7546

GLAMORGAN EDUCATION COMMITTEE

SCHOOL OF MINES AND TECHNOLOGY, TREFOREST

Applications are Invited for the POST of FULL-TIME LECTURER in MECHANICAL ENGINEERING.

Candidates should possess an Engineering Degree or equivalent qualification; preference will be given to candidates with special knowledge in Engineering Drawing and Design.

Salary in accordance with Burnham Scale, with consideration for Works Experience.

Applications, on official forms, which may be obtained on receipt of a stamped addressed envelope, must reach the undersigned not later than the 20th August, 1941.

F. E. REES,
Director of Education.

County Hall, Cardiff. 7649

TO ADVERTISERS UNDER BOX NUMBERS IN SITUATIONS OPEN SECTION.

For the benefit of applicants, the Proprietors are prepared to insert brief notices that vacancies are filled, upon receipt of notifications from the Advertisers. These notices (limited to one line) will be free of charge, and co-operation is asked for.

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE

ARRANGED FOR CARD INDEXING

(TABLE OF CONTENTS, PAGE 72)

Historic Accidents and Disasters No. III (P. 66)
THE ENGINEER, 1 - 8 - 41

War Inventions (P. 68)
THE ENGINEER, 1 - 8 - 41

Wages and Wisdom (P. 72)
THE ENGINEER, 1 - 8 - 41

South Portland Shipyard, Maine (P. 71)
THE ENGINEER, 1 - 8 - 41

Estimation of Restriking Voltage Characteristics of Supply Networks (P. 75)
(J. S. CLIFF) THE ENGINEER, 1 - 8 - 41

Supply of Technical Equipment to the Army (P. 67)
(MAJOR K. H. TUSON) THE ENGINEER, 1 - 8 - 41

HYDROJET ASH & DUST SLUICING
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INDEX TO ADVERTISEMENTS, PAGE 51

WAR DAMAGE

The Proprietors of THE ENGINEER do not accept any responsibility for damage which may be done by enemy action to Advertisers' printing blocks, either at the offices of publication or our Printers.

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SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

IMPORTANT

Advertisers in Situations Open Column should make themselves acquainted with the terms of

STATUTORY RULES & ORDERS
1940 No. 877

RESTRICTION ON ENGAGEMENT ORDER

WANTED, ENGINEER of Managerial Capacity on Machinery and Plant Installation in a large Rubber Factory in the London area. His training should be versatile, covering Steam, Hydraulic, Electrical, and Mechanical Work. In replying, give experience, age, and salary required.—Address, P3426, The Engineer Office. P3426 A

WANTED, GENERAL WORKS MANAGER for Steel Foundry doing 100 tons per week. Foundry experience preferred, but not essential.—Address, giving full particulars of experience, &c., 7653, The Engineer Office. 7653 A

SITUATIONS OPEN

WANTED, WORKS MANAGER for Small Engineering Works, London, engaged on Precision work; good opening for the right man.—Address, with fullest particulars, 7654, The Engineer Office. 7654 A

ERECTION SUPERINTENDENT. — APPLICATIONS are INVITED by a firm of contractors to the Gas and Coking Industries for the POSITION of ERECTION SUPERINTENDENT, who would be required to Supervise all Erection and Putting to Work of Mechanical Handling Plant and Stoking Machinery; knowledge of Carbonising and General Gasworks and Coke Oven Practice will be an asset. State salary required, age, and full details of experience.—Address, P3425, The Engineer Office. P3425 A

EXPERIENCED MAN WANTED, with Technical and practical knowledge of Forgings made in Dies, both upset and drop forgings. To be capable of taking full charge of plant in Lancashire. State age and experience.—Address, 7629, The Engineer Office. 7629 A

SALES ENGINEER REQUIRED by Leading Flow Meter and Industrial Instrument Manufacturers. Protected factory in N.W. London. Excellent progressive position for good man. Technical training to degree standard or equivalent essential.—Address, stating age and salary required, 7627, The Engineer Office. 7627 A

SITUATIONS OPEN

SHIFT ENGINEERS REQUIRED for Large Ammonia Refrigeration Plant of latest type. Experience, age, references, &c., to DOCK MANAGER, Cymric Buildings, Bute Docks, Cardiff. 7646 A

THE Post You Are Seeking May Not be Advertised in this Column, but do not lose the Opportunity of Bringing Your Requirements before all those who would be interested and could employ you. An Advertisement in the "Situations Wanted" Column would be seen by all Leading Engineering Concerns for a cost of Four Lines, 4s.; 1s. for each Additional Line. There is no better way of covering so large a field for such a small charge.

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ENGINEER, M.I.E.C., Age 39, DESIRES CHANGE. At present chief engineer of a hospital in the London area. Widely experienced in steam power generation, heating and hot water services, electrical power plant, transport maintenance and administration. Willing to go abroad.—Address, P3410, The Engineer Office. P3410 B

GRADUATE in Civil Engineering, 21 Years Old, strong in mathematics, DESIRES PAID POSITION with good firm of consulting engineers for gaining experience.—Address, P3424, The Engineer Office. P3424 B

MECHANICAL ENGINEER, A.M.I.E.I. (52), REQUIRES POST; experience 25 years, works manager, general foreman, tool-room foreman, chief mechanical inspector; good credentials.—Address, P3419, The Engineer Office. P3419 B

QUALIFIED ACCOUNTANT, with Degree, SEEKS SUITABLE POST; Czech citizen, aged 34, not eligible military service. Good English references.—Address, 7658, The Engineer Office. 7658 B

TANKS AND EXCAVATORS.—MECHANICAL ENGINEER (45), energetic, with American experience and also commercial, DESIRES POSITION in connection with sub-contracting or production. Apprenticeship I.C. engine manufacture.—Address, P3401, The Engineer Office. P3401 B

WORKS PROGRESS MANAGER REQUIRED. Engineer, 30-45, with knowledge of Foundry Work, particularly in light alloys. Must be determined in purpose, but tactful. The position offered is a progressive one with a well-known company of good reputation. The company situated in the London area is not seeking an employee merely for wartime emergency. Salary commensurate with qualifications.—Address, P3411, The Engineer Office. P3411 B

WORKS MANAGER (49) for Foundry and Engineering Shops; wide experience of general engineering, including heavy commercial automobile manufacture throughout, armoured car, war tanks, and aircraft components; for last ten years as works manager with firm employing 1000 employees; DESIRES CHANGE. Conversant with male and female labour, training, and remuneration systems.—Address, P3420, The Engineer Office. P3420 B

DRAUGHTSMAN ENGINEER (30), University Degree in Engineering, applied for A.M.I.M.E.; Czechoslovakian; initiative, drive; six years' D.O. and workshops experience; SEEKS CHANGE. Preference given to position as assistant plant engineer in chemical or allied factory.—Address, P3417, The Engineer Office. P3417 B

For continuation of Small Advertisements see page 52

AUCTIONS, Page 52
FOR SALE, Page 52
SUB-CONTRACTING, Page 52
COMPANY MEETING, Page 2
PARTNERSHIPS, Page 52
PATENTS, Page 52
PUBLICATIONS, Page 52
MACHINERY, &c., WANTED, Page 52

For Advertisement Rates see First Column Overleaf

CLASSIFIED ADVERTISEMENTS CLOSE FOR
PRESS—NOON WEDNESDAYS

The Engineer

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(including postal charges)

Le prix de l'abonnement est accepté en livres sterling, ou dans la monnaie du pays d'origine au cours du change au moment de la commande.

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Moore Cottrell Subscription Agency, North Cohocton
BOSTON: F. W. Faxon and Co., 63–69, Francis Street

Entered as second-class matter at the Post Office, New York, N.Y., December 12th, 1896, under the Act of March 3rd, 1879 (Section 397, P.L. & R.).

U.S.S.R. ... ... LENINGRAD: Meshdunarodnaja Kniga, Prospect Volodarsky, 53A
MOSCOW: Kuznetski Most 18

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PAPER SUPPLIES

With a view to the conservation of paper, readers are advised, in the interests of all concerned, to place a regular order for THE ENGINEER with their newsagent or direct with the Publisher.

"THE METALLURGIST"

This Supplement, which deals with the Science and Practice of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER each alternate month. Next due, August 29th.

ADVERTISEMENTS

The charges for Classified Advertisements are 1/- per line up to one inch—minimum charge 4/-; those occupying one inch or more at the rate of 12/- per inch. Orders must be accompanied by a remittance. The rates for Displayed Advertisements will be forwarded on application. Classified Advertisements cannot be inserted unless delivered before TWO o'clock on Wednesday afternoon.

Letters relating to the Advertisement and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of THE ENGINEER.

Postal Address, 38, Essex Street, Strand, London, W.C.2. Teleg. Address, "Engineer Newspaper, Estrand, London." Tel., Central 6565 (10 lines).

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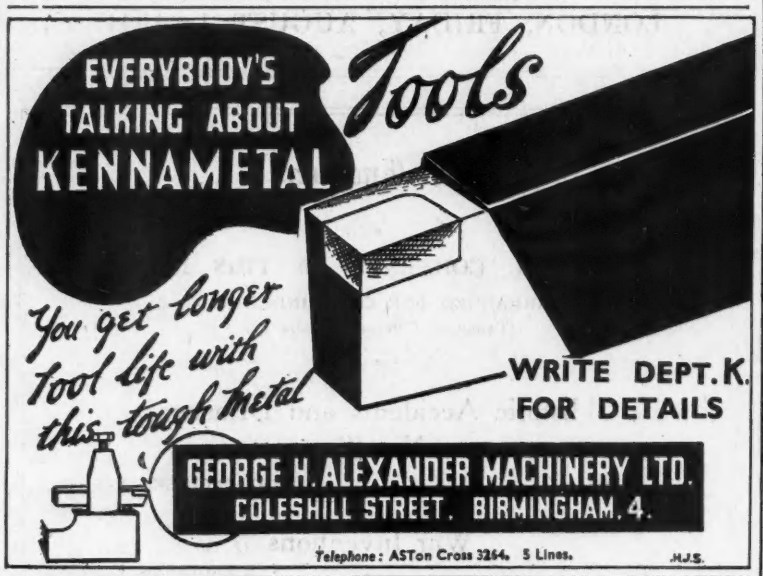
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The Engineer
WAR EMERGENCY DIRECTORY 1941
A strictly limited number of copies of the above has been printed. The booklet on this occasion contains only the names of Firms with their present addresses, telephone numbers and telegraphic addresses. It is believed that this will serve a useful purpose and applications for copies will be dealt with in rotation.
Write to— The Manager, "THE ENGINEER," 28, Essex Street, Strand, London, W.C.2

COMPANY MEETING

PETER BROTHERHOOD LIMITED

DIVIDEND OF 20 PER CENT.

FURTHER EXPANSION OF BUSINESS

MR. A. M. NEAL'S ADDRESS

THE Thirty-fourth Ordinary General Meeting of Peter Brotherhood Limited was held yesterday at Winchester House, Old Broad Street, London, E.C. Mr. Alexander M. Neal, A.C.G.I., A.M.I.C.E. (the Chairman of the Company), presided.

The SECRETARY (Mr. Joseph Gerrard) having read the notice convening the meeting and the Auditors' report,

The CHAIRMAN said: Gentlemen, I wish first of all to apologise for the absence of Admiral Haddy, who is remaining at the works in order that all the directors should not be absent at the same time.

I should also like to remark upon the presence on the platform for the first time of Mr. A. W. Viney, who was elected to the board during the year. Mr. Viney has been with the Company since 1921, during which period his lifelong knowledge of the work of the department which he controls has been of the greatest assistance to us. You will be asked later in the proceedings to confirm our appointment of Mr. Viney as a director.

As the directors' report and statement of accounts have already been circulated, may we take them as read?

SATISFACTORY CASH POSITION

Although, gentlemen, it is not possible, for obvious reasons, to go so much into detail as in other years, I should like, if I may, to make a few remarks on the Balance Sheet and Accounts which have been circulated to you. If you will kindly refer to the Balance Sheet. On the Assets side the increases in the first three items reflect a considerable increase in the trading of the company during the year. In view of the expansion of business and the large payments we have necessarily made for material for contracts now in hand, I think you will agree that the cash position is satisfactory, although this figure will, of course, naturally be considerably reduced when we have made our contribution to Excess Profits Tax and Income Tax for the year.

The other items on the Assets side do not call for special comment, with the exception perhaps of the last item—Air Raid Precautions Suspense Account—at £17,662. Towards this you are to-day, as you will note from the Directors' Report, asked to agree to set aside the sum of £5,000, which, with the sums we have since March 31st last recovered from the Government and with the amounts we expect to receive in the future, should ultimately liquidate this item from the Balance Sheet.

On the Liabilities side the increase in sundry creditors of £47,206 reflects again the increased amount of work carried out, but provision for taxation at £100,000, against £63,500 last year, is a reminder of the heavy burdens which must quite properly be borne.

PROFIT AND DIVIDEND

Turning to the Profit and Loss Account at the bottom of the page, the trading profit for the year, before providing for Income Tax and Excess Profits Tax, is £161,969, against a figure last year of £139,050, but the Income Tax and Excess Profits Tax reduce the amount of net profit this year available for distribution and for other purposes to £61,969, against £75,550 last year. The trading profit for the year has not increased in the same ratio as the turnover; this is due partly to production difficulties unavoidably experienced in these times, but chiefly to the very keen watch kept upon contract prices by the costing departments employed by those for whom we work.

The question of a final dividend has been carefully considered by your Board, and, after taking the advice of our financial adviser, Mr. C. J. G. Palmour, we are of the unanimous opinion that in view of the large amount payable in Excess Profits Tax and Income Tax the shareholders are entitled to as large a dividend out of the amount remaining as is reasonably possible.

Accordingly, after setting aside the sum of £5,000 already referred to for Air Raid Precautions and a similar sum for general reserve, we have unanimously decided to recommend the payment of a final dividend of 12 per cent. on the Ordinary shares, making, with the 8 per cent. interim dividend already paid, a total dividend for the year of 20 per cent. on the Ordinary shares.

It is interesting to note that this rate of 20 per cent. on the nominal Ordinary share capital represents some 9·3 per cent. on the actual capital (other than Preference capital) employed in the business.

TRIBUTE TO EXECUTIVE AND STAFF

It is usual here to make some remarks as to the future. This, under existing circumstances, you will understand, is impossible. We take our instructions from the authorities who alone are in a position to know in what direction we can be most useful. Every person connected with the firm has been working and will continue to work to his (or her) utmost capacity. Of no one is this more true than of our works manager, Mr. W. T. Freestone, and of the whole of the works staff, who continue to expend their energies very freely in the interests of the work in hand.

I now have pleasure in moving the adoption of the Accounts and the appropriation of profits in accordance with the recommendation of the directors which you have before you.

Mr. W. T. FREESTONE, M.I. Mech. E. (Deputy Chairman), seconded the resolution, which was carried unanimously.

The final dividend as recommended was approved.

The retiring directors (Mr. W. T. Freestone, Mr. F. H. Davis, and Mr. A. W. Viney, M.B.E., A.M.I.C.E.) were re-elected; and the Auditors (Messrs. Whinney, Smith and Whinney) having been reappointed, the proceedings terminated.

MANUFACTURERS' CATALOGUES

"The Engineer" will be glad to receive catalogues, lists of manufacturers' trade names, etc., from firms for inclusion in the files of the Enquiry Department.

A Seven-Day Journal

Location of Industry (Restriction) Order, 1941

THE control of factory and storage premises, which was set up by the Board of Trade to co-ordinate the requirements of all Government Departments for factory and storage accommodation and to ensure that these requirements are met with a minimum of disturbance to other essential production, is now in operation and is consulted by all Government Departments and local authorities before premises are requisitioned or otherwise taken over by them. As announced by the President of the Board of Trade in the House of Commons on April 29th, it has been decided to extend this control to the use of premises by private firms, since the increased demands for factory and storage space, which it is the function of the control to satisfy, now make it necessary to prevent the uncontrolled use of existing accommodation which might be needed for essential purposes. The Location of Industry (Restriction) Order, 1941, has now been made and will come into operation immediately. This Order provides that no person may, without a licence, issued by the Board of Trade, carry on at any factory or warehouse having an area of 3000 or more feet super any trade or business not carried on there previously, or carry on at other premises having an area of 3000 or more feet super, whatever their previous use, a business of production or storage. The Order does not apply to shops or to new buildings and a general licence is being issued providing for the use of premises for temporary storage purposes without a specific licence. Special consideration will be given to applications by firms dispossessed by enemy action or through other causes outside their control to use alternative premises in the immediate vicinity of their former place of business. An explanatory memorandum explaining in more detail the scope and purpose of the Order and the method of applying for a licence is available either from the Headquarters or Regional Offices of the Control of Factory and Storage Premises, Board of Trade, or from local Chambers of Commerce. Copies of the Order (S.R. & O., 1941, No. 1100) will be obtainable at H.M. Stationery Office or through any bookseller on August 5th.

The New Tank Board

IT was officially announced on Sunday, July 27th, that Lord Beaverbrook, the Minister of Supply, has appointed a new Tank Board, of which the following are members :—Mr. Geoffrey Burton, Chairman ; Mr. Oliver Lucas, who will take charge of design and development ; and Mr. George Usher, the Director-General of Tank Supply. In addition to these appointments, Major-General Macready, Assistant Chief of the General Staff, and Major-General Pope, Director of Armoured Fighting Vehicles, have been appointed to the Board by Captain Margesson, the Secretary of State for War. It is also announced that Colonel Green, of the Harriman Mission from Washington, will advise the new Board on design and production and will act as Liaison Officer with the United States. Major-General Crawford has been appointed to act as deputy to Mr. George Usher, the Director-General of Tank Supply, who is managing director of International Combustion, Ltd., and chairman of Aberdare Cables, Ltd.

German Warships Bombed

ON Friday, July 25th, further particulars were made available by the Air Ministry of the great Royal Air Force daylight operations on Wednesday and Thursday last week against German battleships and a cruiser which were anchored at Brest. Six different types of bombers took part in the attack, and they included the four-engined American "Flying Fortresses," now named "Fortresses" ; the new British four-engined bombers, "Stirling" and "Halifax" ; and the twin-engined machines of the "Hampden," "Whitley," and "Wellington" types, which have already given outstanding service. In the whole series of operations from Wednesday to Thursday our losses were fifteen bombers and seven fighters. The enemy losses are known to have included thirty-three fighters in the operations on the "Scharnhorst" and the "Gneisenau." No official claim is made with regard to the obtaining of direct hits on the "Prinz Eugen," now docked at Brest, but there is every reason to believe that she suffered damage in more than one place, and it seems likely that she will be unable to put to sea for some little time. According to the official report the "Gneisenau," which was docked at Brest, suffered heavy damage from heavy armour-piercing bombs, and will, it is certain, need considerable repair before she is again ready for service. The "Scharnhorst," it was revealed by the Coastal Command reconnaissance machines, had taken the advantage of bad weather to slip out of port, and hugging the coast had reached the harbour of La Pallice, about 240 miles to the south of Brest. In our heavy attacks this ship was hit more than once, one bomb exploding with great force on the stern of the ship. The exact extent of the damage has not yet been made known. When the "Scharnhorst" had left Brest, the Germans, with the aid of a 530ft. oil tanker and other small ships at the bow and stern of the tanker, managed to construct a camouflage canopy fitted with devices to resemble the superstructure of the "Scharnhorst." But the reconnaissance machines soon detected differences in the concealment scheme, although they had to face a very heavy barrage. By means of smoke trails and traces of smoke screens, the path of the real "Scharnhorst" was traced, and she was discovered inside the pier of the outer jetty at La Pallice.

Technical Aid for Russia

THE Ministry of Home Security announces that it has placed two more of its technical officers at the disposal of the Russian Government. They are Professor W. N. Thomas, Professor of Engineering at University College, Cardiff, who was attached to the Department of Research and Experiment of the Ministry of Home Security ; and Captain L. M. Glasson, M.C., one of the Ministry's Directorate of Camouflage. Professor Thomas is a member of the Institution of Civil Engineers, a member of the Institution of Mechanical Engineers, a member of the Institution of Structural Engineers, and an associate of the Royal Institute of British Architects, who has specialised in research work on structural precautions. We may recall that two fire officers were recently lent to the Russian Government by the Ministry of Home Security. They are Colonel Symonds, who was formerly the Chief Fire Adviser to the Home Office ; and Chief Technical Officer to the Fire Prevention Executive ; and Colonel Croad, who was head of the Technical Staff of the London Civil Defence Region.

Control of Factory and Storage Premises

THE Board of Trade announced on Monday, July 28th, that four new appointments have been made by the Ministries of Supply and Food in connection with their storage programmes and by the Board of Trade in connection with the work of the control of factory and storage premises. Mr. T. Muir Wilson, formerly Regional Controller of Factory and Storage Premises under the Board of Trade for the Northern Region, has been transferred to the Ministry of Supply as from August 1st next. He is a director of Blackwood, Morton and Sons, Ltd., and Cooke Sons and Co., Ltd., carpet manufacturers, and was formerly member of the Carpet Trades Export Group Executive Committee and the Committee on Concentration of Production of the Carpet Trade. Capt. S. N. Whibley, formerly Regional Controller of Factory and Storage Premises under the Board of Trade for the Eastern Region, has been appointed Director of Warehousing at the Ministry of Food. He is the managing director of Clarke, Nickolls and Coombs, Ltd., the confectionery manufacturers, and has a long record of local government service and trade conciliation experience. Mr. S. A. Sadler Forster, formerly Regional Co-ordinator at the headquarters of the Control of Factory and Storage Premises, Board of Trade, has been appointed Regional Controller of Factory and Storage Premises, Board of Trade, in the Eastern Region. He is the manager of the Industrial Development Department, Welwyn Garden City, Ltd., and past Chairman of the Industrial Section of the Association of Development Officers. Viscount Templetown has been appointed Regional Controller of Factory and Storage Premises, Board of Trade, in the Northern Region. He is Vice-Chairman of National Council for Physical Training and Research, Scotland, a member of the National Youth Committee, and Independent Chairman of the Scottish Cement Workers' Association, as well as a member of the Scottish Development Council.

Increase in Port Charges

AT the annual general meeting of the London General Shipowners' Society, which was held on Thursday, July 24th, in London, in the Council Chamber of the Chamber of Shipping, the chairman, Mr. J. K. Swire, in presenting the report of the Committee, referred to the large increases which the Port of London Authority had found it necessary to make in their charges. The Society had been informed that even these increases would not meet the whole of the Authority's deficiency in revenue. Whilst it was perhaps reasonable that these increases in so far as they had been brought about by rises in normal working costs should be borne by the industry, the Committee felt that at any rate where they were the result of diversion of shipping ordered by the Government and other wartime causes beyond the industry's control, it was only fair that they should be borne by the nation as a whole and not by the few ships and limited quantity of goods passing through the port. It would be realised that the ships which continued to come to London and so became subject to these charges did so by Government direction no less than the ships which were diverted to other ports. The Committee associated itself with others in seeing that this view was placed as strongly as possible before the Government, and the Government had apparently accepted the principle that increased costs should only be passed on in the form of increased charges up to 100 per cent. over pre-war.

Progress in War Production

IN the course of his review of the war effort in the House of Commons on Tuesday, July 29th, Mr. Winston Churchill, the Prime Minister, said that production in all forms was gaining steadily and swiftly, not only in volume, but, even at its present high altitude, in momentum. He dealt at length with the proposal that a Minister or Ministry of Production should be formed. There was no need, he said, for such a Minister, as, for good or ill, in any sensible organisation, it was necessary to leave the execution of policies already prescribed to the responsible Ministers and Departments. Dealing with outputs, Mr. Churchill stated that the Ministry of Supply output in the last three months had been one-third greater than in the three months of the Dunkirk period. Although the Navy, Army, and Air Force were larger, the Ministry of Supply had one-third more people working in its factories. Each man was turning out on the whole each day as much as he did in that time of almost superhuman effort. In the last three months we had made more than twice the number of field guns we made in the Dunkirk period, and the ammunition turned out was half as much again. The combined mercantile and naval shipbuilding now in progress, Mr. Churchill said, was bigger, not only in scale, but in current daily execution, than it was at any period in the last war, and, of course, the work was now immeasurably more complex than it was then. In aircraft production it was foolish to calculate only by machines, though these had largely increased, as one machine took 5000 man-hours and another 75,000 man-hours. Judged by the test either of numbers or of man-hours in aircraft production, the increase above the spurt of a year ago was substantial. As for bombers, in the past year in British production alone, taking no account of the rapidly expanding United States imports, we had doubled our power of bomb discharge on Germany at 1500 miles range, and in the next few months—though this time taking account of the American imports—we should double it again. In the last war we had many bitter and devastating strikes, and in the final two years nearly 12,000,000 working days were lost through labour disputes. So far in the whole twenty-three months of this war we have lost less than 2,000,000 days.

Machine Tools and the War Effort

IN another part of his review, Mr. Churchill dealt with the use of machine tools in the war effort. He said that there had been three censuses taken of machine tools—in June, 1940, November, 1940, and a partial census of the principal firms in June, 1941. The Supply Ministers were responsible for the use of machine tools to the best advantage. There was, however, a Controller of Machine Tools, Mr. Mills, a business man of the highest repute, whose sole duty was to supervise their employment by all Departments. By the joint agreement and goodwill of the three Supply Departments, that gentleman had independent powers, and he had his own representatives throughout the country. Although he was actually under the Ministry of Supply, he could remove any machine tool that was idle from any Department or factory and transfer it to another, and he was continually exercising his powers. There were, however, three limiting factors in the use of machine tools. The first was any shortage that might exist of skilled labour, which we were striving by every method to overcome. The second was the undoubted difficulty we had found in working to the full extent night shifts under conditions of air attack. But it was the third limiting factor which gave rise to the complaints which were made. The Prime Minister said that he was told that there were between 200 and 300 kinds of machine tools in the census, and their effective use was governed by certain precision machine tools of which there was a shortage. Intense efforts were being made to break down those bottle-necks. Moreover, the precision tools of which there was a shortage varied sometimes with the varying demands of war production, and sometimes the block was found here and sometimes there. Thus, when people went about the country and saw at some garage or factory or in some small firm a number of machine tools of the lower grade or of peacetime specialised types lying idle, the explanation was not that the supply of machine tools was not organised to the highest degree, but because, owing to the shortage at key points of special precision types, many of those tools could not be brought into action.

Historic Accidents and Disasters

No. III

(*Continued from page 35, July 18th*)

H.M.S. "Captain"—Part I

AT 12.15 a.m. on September 7th, 1870, H.M.S. "Captain," a steam-and-sail turret ship of 4272 tons, was off Finisterre under double-reefed fore and main topsails, close hauled on the port tack. The wind, about north-west, was very squally, with rain and a heavy sea. The ship made a very heavy roll to starboard, and before she had time to recover, a sea struck her and threw her on her beam ends. She turned bottom upwards, and ten minutes later sank stern first. About twelve hours later her gunner and seventeen men landed from a launch on French soil. They were the sole survivors of the ship's company. Those who perished numbered 482. Included among them were the ship's commander, Captain H. T. Burgoyne, V.C.; her designer, Captain Cowper Coles, R.N.; and a son of Mr. Childers, the First Lord of the Admiralty.

On a memorial tablet in St. Paul's Cathedral the public can still read an extract from the report of the Court of Inquiry appointed by the Admiralty to investigate the cause of the disaster. "The Court before separating," so the inscription runs, "find it their duty to record the conviction they entertain that the 'Captain' was built in deference to public opinion expressed in Parliament, and through other channels, and in opposition to the views and opinions of the Controller and his department, and that the evidence all tends to show that they generally disapproved of her construction. It further appeared in evidence that before the 'Captain' was received from the contractors a grave departure from her original design had been committed, whereby her draught of water was increased about two feet and her freeboard was diminished to a corresponding extent, and that her stability proved to be dangerously small, combined with an area of sail under these circumstances excessive. The Court deeply regret that if those facts were duly known and appreciated, they were not communicated to the officer in command of the ship, or that, if otherwise, the ship was allowed to be employed in the ordinary service of the fleet before they had been sufficiently ascertained by calculation and experiment."

The Court was composed entirely of admirals and captains on the active list. Individually and as a body its members, it is certain, felt restricted in expressing any conclusions critical of the Admiralty which they might hold or reach. Of the three sentences from the Court's report which we have quoted, the first must justly be regarded as an unworthy attempt to exculpate the Admiralty and to lay prime responsibility for the disaster on private individuals. The second sentence is misleading, in so far as it may be read to imply that the "Captain" was sent to sea with a concealed defect, which was not openly revealed until it was disclosed in evidence brought to light during the Court's investigations. The final sentence, with its evasive "if, or if otherwise," wrongly implies that the Court was unable to obtain certain information essential to the formulation of a definite judgment on a vital point.

The country was shocked by the disaster to the "Captain," the worst naval calamity which had occurred since the "Royal George" sank at Portsmouth in 1782. The findings of the Court of Inquiry increased rather than diminished the nation's distress, and added fresh fuel to the bitter controversy which arose concerning the cause of the mishap and the persons responsible for it. Eventually, the First Lord of the Admiralty, Mr. Childers, himself investigated the subject, and issued a voluminous memorandum upon it. From the welter of conflicting testimony, charges, denials, and countercharges, Mr. Childers, without shrinking from exposing and censuring the shortcomings and mistakes of his own Department, succeeded in unravelling a considerable measure of the truth, but even to-day it is virtually impossible to tell the true story of the "Captain" in all its details. It is a story the technical aspects of which are inextricably entangled with the personalities of those who played the chief parts in the tragedy. On the technical side, the story can, in a way, be presented quite simply. It is the narrative of an experiment which went wrong. But why it went wrong, why it was allowed to go wrong, and why its failure should have involved the deaths of nearly 500 gallant seamen, are aspects of the disaster which cannot clearly be omitted from any account of it, technical or otherwise. In dealing with these aspects, however, the historian has a difficult task, if he would be scrupulously fair to all concerned. He must not only sift a vast mass of conflicting evidence, but must constantly be alert to the danger of being misled by contemporary recordings of opinions coloured by violent partisanship, personal animosity, professional jealousy, and timidity in the matter of disclosing the truth.

The key to the whole story is very probably to be found in a dislike felt at the Admiralty or in certain of its departments—notably in that of the Controller and the Chief Constructor—against the construction of a novel type of warship in a private yard to the designs of a private individual. Such a dislike might have been inspired by perfectly legitimate, reasonable and honest motives. It must be remembered that up to the 'sixties of last century the designing and building of warships had been almost entirely in the hands of the Admiralty and the royal dockyards. It would therefore have been fully understandable if certain Admiralty officials had in the exercise of their professional judgment, and completely unbiassed by any motive of narrow jealousy, felt opposed to placing the order for an important new type of warship with a private firm under conditions which left them with little or no control over either its design or construction. It is to be feared, however, that in the case of the "Captain" rational opposition of this kind was, from the first, more than tinctured by professional jealousy, pure and simple.

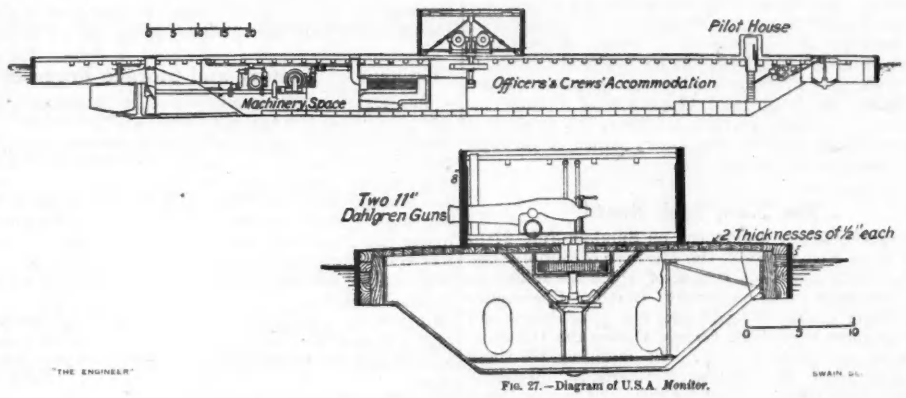

Fig. 27.—Diagram of U.S.A. *Monitor*.

ERICSSON'S "MONITOR"

On the Admiralty side the principal characters entering the story were Admiral Sir Spencer Robinson, the Controller of the Navy, and Mr. E. J. (later Sir Edward) Reed, the Chief Constructor. The narrative is slightly complicated by the fact that on July 9th, 1870, two months before the disaster, Mr. Reed resigned his office and was succeeded in it by Mr. (Sir Nathaniel) Barnaby. It will be seen presently that although Mr. Reed occupied the position of Chief Constructor during the years in which the "Captain" was being designed, built and tried, the loss of the ship *might* have been averted had Mr. Barnaby or those under him, acted quickly on knowledge concerning her stability which became available some few weeks before the disaster. Mr. Reed's resignation of his office at what must be regarded as a critical period in the history of the "Captain" might easily be represented as the last resort of a man who had consistently protested against the design of the ship and had found his protests falling on deaf ears. There is ample evidence to the effect that Mr. Reed disapproved of low-freeboard masted turret ships in general and of the "Captain" in particular. In April, 1868, he read a paper on the "Stability of Monitors under Canvas" before the Institution of Naval Architects, in which he showed that such vessels would be "desperately unsafe." Again, according to Mr. Reed himself, his dislike of the "Captain" went so far that while she was being built he forbade any member of his staff to "approve" even the most minor detail, the strongest phrase permitted being that "no objection would be offered." Yet again, and once more according to Mr. Reed himself, a year or so before the disaster, when the First Lord of the Admiralty expressed a desire to have a number of "Captains" built, he carried his protests so far as to retire from his duties and offered to submit his resignation. The First Lord's proposal was withdrawn and Mr. Reed resumed his duties. Shortly afterwards he resigned his office as Chief Constructor. The reasons for his resignation are not known, but he himself has left it on record that they had nothing to do with the "Captain."

Of those outside the Admiralty who entered prominently into the case, the chief actors were Captain Cowper Coles and Mr. William and Mr. Henry Laird, of Laird Brothers, shipbuilders, Birkenhead. Captain Coles is generally described as the designer of the "Captain" and Laird Brothers as the builders. It appears, however, to be almost certain that Captain Coles was responsible only for the general idea of the ship and that Laird Brothers did most of the actual designing. It is a little difficult at this date to assign to Captain Coles his true position in the history of naval architecture. In Mr. Childers' memorandum, to which we have referred above, he is described as the man to whom the country owed the establishment of the turret system of mounting guns on warships. Again, in the ninth edition of the "Encyclopædia Britannica," published in 1884, it is stated that he advocated the turret system as opposed to Mr. Reed's broadside system. These statements, read in conjunction with the first sentence of the inscription on the St. Paul's memorial, clearly suggest a picture of Captain Coles, backed by members of Parliament and by the Press, persuading the Admiralty to adopt the turret system against the strongly expressed opinions of its experts, who clung tenaciously to the old-fashioned broadside system, which had served the Navy so well from its earliest days. This impression, it can be said with certainty, is erroneous.

There is to be found in our issue of October 21st, 1870, a letter from a correspondent which describes Captain Coles as a man inventive and ingenious, but rash, superficially informed concerning naval construction and intolerant of the opinions of those who had made the science of ship designing their life study. There is certainly abundant and fully substantiated evidence that he had completely unjustified confidence in the safety of the "Captain," and, to use the words of a member of the Court of Inquiry, was "perfectly blind to anything but the merits of his own invention." During one of the ship's earlier trials Captain Commerell, of the "Monarch," discussed the question of her safety with Captains Cole and Burgoyne. Captain Coles "altogether laughed" at the suspicion that she might capsize and asserted that she could not go over beyond a certain point—6 or 7 degrees. About six hours before the disaster Admiral Milne, in command of the squadron with which the "Captain" was cruising, called Captain Coles' attention to the fact that the lee side of her deck was under water, that the sea was washing over it from fore to aft and that "things looked ugly." Captain Coles replied that he had no fear and that there was not the slightest danger. Yet the amazing truth is that right up to his and the ship's last moment he was entirely ignorant concerning the magnitude of her metacentric height and of the angle of heel at which her righting moment reached its maximum value. Captain Coles' confidence in the seaworthiness of the ship was, as a correspondent of ours expressed it,

inspired by the fact that ignorance of danger is a well-known preservative from fear.

It may here be interpolated that Captain Burgoyne was an intrepid and capable naval officer. That he took a grave risk in keeping the "Captain" under the sail which she was carrying on the fatal night is beyond doubt. He was, however, a close friend of Captain Coles, shared his confidence in the ship's seaworthiness—and his ignorance of her stability characteristics—and never by word or deed said or did anything which might have suggested that his friend's ship was other than a complete success.

The turret system of mounting guns in warships was not invented either by Captain Coles or in this country. The first, or the first noteworthy, example of a turret ship was the United States ship "Monitor," built for the Federal Government to the designs of the Swedish naval engineer, John Ericsson. This ship had a length of about 165ft., a beam of about 41ft., a draught of 10ft. and a freeboard of 5in. At the mid-point of her length she carried a circular rotating armoured turret containing two 11in. Dahlgren guns. She had no masts and her deck was free of all structures except the central turret and a small pilot house situated near the bow. The "Monitor" was launched on January 30th, 1862, and on March 9th fought her celebrated action with the Confederate warship "Merrimac." Her alleged victory over her opponent drew attention to the merits of the low freeboard turret type of ship. In this country the lesson learnt was put into practice in the first instance by cutting down the "Royal Sovereign," a wooden warship of 121 guns and 3760 tons, built in 1857, and fitting her with turrets. The superintendence of the actual work carried out on the "Royal Sovereign" was placed in the hands of Captain Cowper Coles. As cut down this ship was deprived of her masts and sails and was intended solely for coastal defence. She was ready for service in her reconstructed form in 1864. Another ship, the "Prince Albert," built of iron, was similarly treated.

It ought here to be noted that Ericsson's prime idea in designing the "Monitor" was to produce a warship which, possessing a very low freeboard and the least possible amount of upper work, would attain a high degree of invisibility. The turret principle of mounting the guns was quite a secondary feature of his design. It was virtually forced upon him by the fact that with a very low freeboard and no upper works there was no possibility of mounting the guns on the broadside principle. The earliest turret ships were therefore turret ships solely because with their low freeboards they could not very well be anything else and not because of any established and recognised advantage accompanying the mounting of the guns in turrets. Several "Monitors" of Ericsson's design were built in the United States. One of them succeeded in crossing the Atlantic and visiting this country. Nevertheless it was fully agreed that their low freeboards rendered them unsuitable for seagoing purposes and that their especial sphere was coastal defence and inshore operations.

Very soon after the appearance of Ericsson's "Monitor" the advantages of the turret system, apart from any consideration of the freeboard question, became recognised. It is manifestly wrong to assert that at this period the Admiralty still clung obstinately to the broadside system; that, beyond cutting down the "Royal Sovereign" and the "Prince Albert" and fitting them with turrets, it would have nothing to do with turrets, whether on low or high freeboard ships, and that the adoption of the turret principle was forced upon it by Captain Cowper Coles, backed by his friends in Parliament and on the staffs of *The Times* and other newspapers. In 1866, at Sir Spencer Robinson's instigation, Mr. Reed began to design turret ships. From the first he vigorously maintained that low freeboard Monitors without masts were suitable only for coastal defence and inshore operations; that if such ships were fitted with masts and sails they would be dangerously unstable, and that if a seagoing masted turret ship were required the low freeboard principle ought to be abandoned. His paper of 1868 before the Naval Architects, to which we have alluded above, was an explicit condemnation of a suggestion which had been made that masts should be mounted on a low freeboard turret ship of the "Monitor" type.

True to his principles, Mr. Reed designed a number of low-freeboard unmasted coastal defence turret ships, including the "Cerberus," the "Abyssinia," the "Magdala" and the "Glatton." For seagoing duties he designed the "Monarch," a *masted* turret ship with a freeboard of 14ft. and, later the "Devastation," an *unmasted* turret ship with a freeboard of only 4ft. 6in. The "Devastation" was the first British seagoing battleship to depend entirely on steam power for her propulsion.

The "Monarch" was laid down in June, 1866, and was launched in May, 1868. She had a length of 330ft., a breadth of 57ft. 6in. and a draught of 26ft. Her engines of 8000 I.H.P. gave her a speed of about 15 knots, and in addition she carried 27,700 square feet of sail. In appearance she was virtually an ordinary broadsider frigate with two twin turrets mounted on her deck in place of the broadside guns. She was not a "Monitor" as regarded her freeboard and was not intended to be one. Captain Coles did not like the design of the "Monarch" and succeeded in persuading the Board of Admiralty that he could produce a better ship, a masted, low freeboard, seagoing, turret ship. It is evident that the proposal to build such a ship combining low freeboard with masts and sails could not have been approved by Mr. Reed, for it went against the requirements which he deemed necessary on the grounds of safety in a seagoing vessel. In spite of contemporary assertions to the contrary, we feel constrained to believe that Mr. Reed spoke the truth when he stated, as he did repeatedly, that he had been opposed on technical grounds to the building of the "Captain" from her inception onwards. The inference is that the Board of Admiralty in its dealings with Captain Coles concerning the building of the "Captain" acted against the advice of its Chief Constructor and probably of that of the Controller of the Navy. On April 24th, 1866, the Board authorised Captain Coles to communicate with Laird Brothers with a view to that firm tendering for the construction of the proposed ship and in July it approved of the ship being built in accordance with one of two designs submitted by Captain Coles in conjunction with Laird Brothers. That the Board in thus acting was in opposition to the views expressed by Mr. Reed and Admiral Robinson is strongly confirmed by the fact that in these early dealings it specified that entire responsibility for the design and efficient construction of the ship was to rest with Captain Coles and Messrs. Laird and that the Controller and Chief Constructor were for the time being to be relieved of all such responsibility.

(To be continued)

The Supply of Technical Equipment to the Army

By Major K. H. TUSON, M.I.E.E., M.I. Mech. E., R.E.

THE long period that elapses between a decision to provide the Army with some new type of equipment and the actual delivery of the equipment in quantity to fighting units is often criticised. While avoidable delays do occur on occasion and informed criticism is valuable, there is little general knowledge of the many essential matters that have to be settled, and the object of this article is to outline briefly the many links in the chain of supply.

Apart from standard articles, such as rifles, a new demand arises either because war developments have shown the need for some new store or from some strategic plan. Equipment for bomb disposal squads may be instanced as an example of the first, while as an example of the second the Cabinet might direct the War Office to prepare to send an expeditionary force abroad. The planning branch of the General Staff would then decide the size and composition of force required and pass the plans to a second War Office branch. This branch, among other functions, is responsible for settling the scale and technical details of the equipment to be taken by the force, and for passing this information to a third branch. Further quantities will be wanted to provide for war damage, reserves, and so on. All these figures are collated and presented to the Ministry of Supply in the form of a consolidated order for so many hundred or thousand articles of equipment by a given date.

It is not proposed to describe the organisation of the Ministry of Supply in detail, but a short account is necessary to enable the reader to follow the subsequent history of the sets. Of the many departments under the Minister, one deals with finance and is consequently concerned with all the Ministry's transactions. Its approval has to be obtained before any contract can be placed. The Contracts Department places all orders and draws up all contracts. There is a department to deal with each of the various categories of stores—ammunition, clothing, guns, and so on. Each department is similarly sub-divided two or three times to deal with the corresponding sub-divisions of the general category of store. The Ministry is staffed with officers and civilians collected from every walk of life with special knowledge of production and of the particular articles with which they have to deal. Royal Engineer and other officers are selected who have a knowledge of the military uses of the equipment as well as a training in engineering and subsequent factory experience.

The branch responsible for producing any new equipment has three separate problems to solve:—

First, design, so that when a store is produced it will meet War Office requirements of "performance." Under this term is included limitations of weight, mobility, &c.

Secondly, planning to produce the store in large quantities.

Thirdly, progress, *i.e.*, assistance to manufacturers in obtaining factory space, machine tools and raw materials.

The organisation for handling the three problems differs in the various branches, but the general principle is to have technical, progress, and planning sub-sections, the three sub-sections dealing with one store being situated in close proximity and working in close contact with one another.

Equipment comes under one of two categories. In the first are articles with purely military uses, such as tanks or military bridges, while in the second are industrial machines, generators, engines, and the like, which at first sight could be ordered "off the shelf." The second category are the easier to deal with, since no basic designs are necessary. We shall later show, however, that many obstacles still have to be overcome even with this class of equipment.

It is an unfortunate fact that few standard commercial articles are suited for Service use without modification. Two common defects are that they are not designed to be weatherproof in the open in any part of the world, and that they are often intended to be operated by engineers and not fighting troops. Again, weight and portability are usually of little peacetime importance while essential for a mobile army.

Another unfortunate fact is that few of the more complex engineering products are absolutely standard, even though sales managers, when negotiating a big order, are often under the impression that they are. Individual customers in peacetime had such a variety of requirements that manufacturers kept designs and factory lay-outs flexible to the detriment of rapid production.

So for new equipment of both categories the first step is for the appropriate research and design establishment to make or have made a prototype which is approved by the War Office as suitable for their needs. This first model is usually not in a production form, so that after War Office approval has been given the production section of the Ministry of Supply has to find suitable manufacturers and with their co-operation produce a final design that is robust, portable, easy to operate and capable of doing its job after rough usage equally well in the snows of Norway or the sands of Libya. The extent to which designs have to be altered to suit manufacturing conditions is well known, and it may be necessary at this stage to refer back to the users, *i.e.*, the War Office, for final approval. In peacetime equipment was subjected to long field trials before adoption. This is, of course, not possible in war, but the fact throws greater responsibility on the engineers responsible for new designs.

General specifications and drawings are then prepared, usually by the Inspection Department which will be responsible for inspecting the production sets, with the collaboration of the design

establishment which originally produced the equipment. Sometimes that establishment is still improving performance after a contract has been placed, in which event so much the worse for inspectors and manufacturers.

Now comes the turn of the production section. The peacetime practice of competitive tendering involved the preparation of detailed specifications and drawings and a considerable amount of work by firm's staffs preparing tenders. All this took time which cannot be spared and is, in addition, not practicable for new types of equipment where it is impossible to estimate a price closely.

In the case of new equipment of the types under consideration here it is a case of finding the most suitable firm with available capacity, or one whose existing contracts are running out, and settling prices later. Here different branches of the Ministry and different Ministries have to consult; for instance, many branches of the Ministries of Supply, of Aircraft Production, the Admiralty and others use the same types of internal combustion engines. Relative requirements and priorities and rates of production have to be considered before a contract can be finally placed. The various methods in use for fixing a fair price are generally known and will not be further discussed here.

The general public might think that soon after this stage is reached equipment would begin to appear, but engineers will realise that this is not the case. At the present time materials must be ordered six months in advance, and so must components such as crankshafts, fuel tanks, and radiators. If a new type of engine is to be used or any other new mechanisms, jigging and tooling is necessary. Engineers without production experience do not always realise the number of jigs required (over 500 in a recent case of one fairly small generating set), and three months seems to be the minimum time delay involved. The process is one that defeats all efforts to hasten it, and it is a question whether it is not sometimes pushed to extremes by production executives who can only think in large quantities. The amount of jigging and tooling to be undertaken for a limited demand is a question of considerable difficulty which deserves an article to itself.

The work of the progress sections of the Ministry starts when a firm is instructed to proceed with a contract. These sections spend their time helping firms over difficulties of factory accommodation and supply of raw materials and components. They suggest alternative sources of supply or alternative articles and reinforce the progress department of the contractor; sometimes raw material control departments dealing with aluminium, non-ferrous alloys, &c., take a hand in the national interest, advise a firm to use a different grade of material or a different material altogether; a plastic, for example.

Even when the first sets ultimately appear off production many problems remain before a steady output of ten or twenty sets a week is reached, and problems indeed continue throughout the life of the contract. Inspection Departments are in touch with experimental designs, and as soon as a contract is placed, and sometimes before, co-operate with the contractor in settling details. One important point not always appreciated by those responsible for placing contracts is the difference between firms suited for mass production and those whose reputation depended on high-quality goods made in small quantities. Sometimes the designs of these latter firms are adopted for Army requirements, and disappointment ensues when they are found unsuitable for production in quantity.

Eventually a steady output is reached and unless it is hampered by air raid damage or other troubles all that remains is to guard against occasional faulty machines slipping through, to produce instruction books, to train the troops in the use of the new equipment and to provide spare parts.

As the Quartermaster-General stressed in a recent broadcast, the supply of spare parts immediately new equipment is introduced is vital, but difficult. Intelligent guesswork has to be used to decide which parts of a new engine will wear first and at what rate. Since the Inspection Departments are the first to have sufficient detailed knowledge of a new store they have to prepare these preliminary lists of spares. The training of troops in new equipment before it is issued is not always possible, and the consequence of such lack of training becomes immediately evident in excessive breakdowns.

The Inspection Departments have been previously mentioned. There are several of these: Inspectorates of Armaments, of Mechanisation (vehicles and tanks), of Engineer and Signal Stores, &c. Their functions are more varied than their title would suggest and include a good deal of design as well as advice to Ordnance and other branches. A description of the peacetime work of one of these inspectorates is given in the two articles mentioned at the end of this one.

Actual inspection and test of bulky articles, such as generating sets, is normally carried out by resident "examiners" (the civilian term would be inspectors). The difficulty of recruiting trustworthy skilled men will be appreciated, especially as versatility is also necessary. Recently some women have been engaged for the less technical articles of equipment.

Readers engaged on Government contracts may have been puzzled by the variety of visitors to their works. It will be seen that production, design, progress, experimental and inspection departments are all concerned with different aspects of any contract, and a contractor may receive visits from representatives of any or all these departments.

While several matters have not been touched on, it is hoped that enough has been said to make clear the many steps involved in providing new equipment, and the impossibility of doing it very quickly, however long the hours worked by all concerned. Readers will agree that none of the steps described above can be left out. Time is saved whenever possible by doing several of them simultaneously, but attempts to produce the articles before the design is settled often lead to greater delay in the end. For complex mechanisms such as a new tank or gun, matters are even more involved. If one small complaint may be permitted, it is at the incurable optimism of everybody concerned, soldiers, engineers, managing directors and officials alike. An amazing number of these, in the face of innumerable cases of machines taking two or three times as long to produce as was expected, persist in saying, "It won't be like that next time," and making plans accordingly. It is bound to be just like that every time.

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War Inventions

At a Ministry of Supply Press Conference, held on Thursday last week, July 24th, Dr. H. J. Gough, F.R.S., M.I. Mech. E., Director of Research in the Department of Scientific Research, dealt with the question of wartime inventions and what happens to them. In introducing his subject, Dr. Gough said that the Inventions Section of the Ministry of Supply was no isolated entity, but it formed a part of the great technical side of the Ministry, concerned as it was, with scientific research and scientific development. It might be said that invention, research and development, both separately and in combination, contributed to a common aim, which might be roughly defined as bringing to the production stage, new and improved weapons for the Army, the Navy and the Air Force, together with new and improved industrial plant and processes, along with many other civil and military needs which were necessary to the war effort at home and abroad. Invention, Dr. Gough reminded his hearers, should not be confused with research and development. It was the constant effort of the Ministry to harness to the national service all these factors, employing special and very personal methods of dealing with the inventor and his proposal. That work involved an unusual degree of contact with the technical and human angles. Facilities were immediately available when required, to examine in detail and to improve promising inventions, giving to the inventor the most careful attention, expert advice and sympathetic understanding.

Research Development

In 1914, at the outbreak of the last war, the civilian research and experimental staff of the War Department numbered, Dr. Gough stated, less than forty all told. The lesson of the value of intensive research by highly trained and technical staff had been well learned during that war and the post-war period, and hence before the outbreak of the present war the War Office—and, later, the Ministry of Supply—possessed five large and well-equipped laboratories staffed by about 800 scientists, including specialists in every branch of applied physics, chemistry and engineering, who were engaged in applying the very latest principles to the design and development of weapons and defences, instruments and machines, and equipment and stores, all of which were needed to meet the complex demands of the modern fighting services. In addition, it had been realised how necessary it was for the Department to avail itself of the research and technical resources of universities and the large industrial organisations. At the present time, Dr. Gough said, much work was going on in these laboratories in addition to a great number of investigations which were being conducted on behalf of other Government research laboratories throughout the country.

Those who were interested in planning and responsible for its carrying out were well aware of the flood of new demands for scientific and industrial investigation which were certain to arise from the actual needs and problems of active service and of the production programme. In order to meet such demands an emergency war organisation was planned, which came automatically into operation immediately on the outbreak of war. Under that scheme a number of leading scientists who were normally employed as professors at universities at once entered the Government research establishments, and were joined by a great number of junior scientists and technicians drawn from many fields of research and development. The Ministry of Supply also took over for the duration of the war several research laboratories complete and certain departments of other laboratories. In addition, in order to meet new needs as they arose, a steady recruitment of skilled staff was begun.

As the war progressed many additional investigations were placed with specially selected universities and industrial research laboratories. Dr. Gough recorded the Ministry's high appreciation of the splendid and unfailing response which had been received to the demands which were made on the universities, industrial concerns and private individuals for personal service and facilities in the war effort.

At the present time, Dr. Gough revealed that the scientific, technical and assistant staff in the direct employ of the Ministry of Supply numbered 2700 persons, while there were about one hundred major investigations being carried out on behalf of the Ministry by highly skilled teams of workers at the universities, the research laboratories of the industrial firms and at the laboratories of the Research Associations. This scheme represented one of the most comprehensive mobilisations of scientific and technical talent that had ever been attempted.

"WHAT HAPPENS TO WARTIME INVENTIONS"

Broadly speaking, the main function of the Inventions Section of the Directorate of Scientific Research, Ministry of Supply, is to examine all inventions of which details can be obtained, with a view to the utilisation of such inventions for the war effort.

A.—*Manner in which Proposals Reach the Directorate.*—Details of inventions are usually obtained:

(1) By letters or other communications sent directly to the Ministry by independent inventors in this country or anywhere in the world who are anxious to make some contribution towards the successful prosecution of the war;

(2) By interviews with inventors who call at the Ministry to explain their proposals;

(3) By suggestions made by members of H.M. Forces, forwarded through Service channels and frequently resulting from the inventor's appreciation, due to his service, of a requirement which is not met by existing equipment, or of an improvement which can be made in existing equipment;

(4) By co-operation with the Patent Office, who notify the Department of the number of any patent application likely to be of Service interest, so that the Department can write to the inventor for details;

(5) By co-operation with the corresponding Department in the Admiralty and the Ministry of Aircraft Production, so that each Department supplies to either or both the other Departments details of such inventions as are likely to be of interest;

(6) By co-operation with technical bodies established in this country by the Governments of German-occupied territories.

(7) Through the Inventions Board established by the British Purchasing Commission and the Inventions Departments of Dominions.

B.—*Preliminary Treatment of a Proposal.*—When a proposal is received it is examined in detail by one of a staff of scientifically trained examiners who are specialists in the various subjects likely to be of interest to the Ministry, so that each proposal is, as far as possible, examined by an individual who is already familiar with the art to which such proposal relates.

C.—*Action with a Proposal of Merit.*—If the proposal seems, from a preliminary examination, likely to be useful, it is sent to the appropriate user, Development or Research Department, depending on the nature of the proposal and the extent to which it has been developed by the original inventor, with comments by the examiner on the technical merits and possible applications of the invention. Even during this preliminary consideration every examiner considers the invention, not only in the particular form in which it is put forward by the inventor, but also in its broadest aspect, with a view to determining whether the invention has any possible Service uses not visualised by the inventor himself. In come cases the examiner, when he can, will suggest possible improvements which occur to him, in order to increase the utility of the original proposal.

An invention for possible Service use is considered by the examiners and by other Departments to whom it may be submitted, from three main aspects, namely :—Whether the invention meets any Service requirements ; whether, if there is a Service requirement for apparatus of the kind suggested, the actual apparatus put forward is technically sound ; and thirdly, whether the proposal presents sufficient advantages over existing equipment to, for example, justify the diversion of production capacity in order to produce the new article.

D.—*Action with a Proposal of Merit Initially Rejected by an Outside Department.*—In some cases it is found that outside Departments to whom the invention is submitted for consideration do not, at first sight, regard the invention with favour, and when, in such instances examiners are not satisfied with the initial rejection of the proposal, they return it for reconsideration with, possibly, comments on the reasons given by the outside Department for the first rejection. The examiners do, when necessary obtain further information from the inventor should they consider that this will be helpful in pressing the adoption of the proposal. Thus, for example, the inventor may be given the opportunity of meeting criticisms made and of contributing towards the solution of problems arising from the proposal.

In the event that an inventor's proposal is recommended for adoption, the inventor is informed and, in some cases, he may be asked to collaborate in the development and production of apparatus based on his invention.

E.—*Action with a Rejected Proposal.*—When a proposal is rejected the inventor is at once informed that no further action is to be taken on his proposal, but it is frequently not possible to give technical reasons for such rejection without disclosing secret information. The inventor is, however, always told when his proposal is similar to one which has already been investigated by the Department, as this may save him expending needless time and work in further development of a proposal which is not novel and which may already be fully developed for Service use. However, even if records may show that a proposal submitted is not novel, this in itself is not a ground for rejecting such a proposal which is fully considered in the light of the ever-changing requirements of war. Furthermore, steps are taken in the case of proposals which are not of immediate use, but may be of use in the future, to ensure that such proposals are reviewed periodically.

In a few cases the inventor is not satisfied with the somewhat terse decisions which the Department is often compelled to give, but such cases are rare and most people realise that during war it is essential that secrecy shall be maintained. In this connection it must be borne in mind that the Ministry has, in the absence of a specific investigation or of the personal knowledge of an examiner, no direct means of judging the *bona fides* of a correspondent and that some of the alleged inventions put forward may be submitted by enemy agents in the hope that the reply sent will disclose information useful to the enemy.

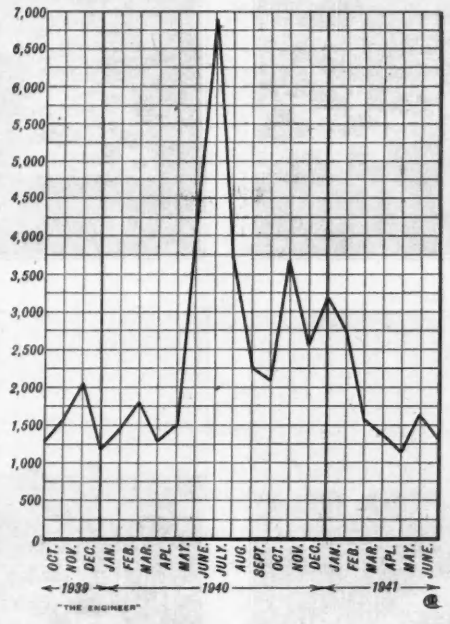
F.—*Interviews with Inventors.*—Any inventors who care to call with details of their inventions are interviewed, if possible, by the expert on the subject to which the invention relates. It is desirable that a brief outline of the proposal should be submitted prior to the interview. After a proposal has been considered either from a written communication or following a preliminary interview, the inventor may, if the proposal seems promising, be invited to further interviews to meet the Department's military advisers and to discuss the proposal with them, or the examiner may arrange to take the inventor to the appropriate outside establishment for such discussion.

G.—*Inspection of Models and Trials.*—An examiner may arrange to visit an inventor to inspect models which cannot readily be sent to the Department or to witness trials.

H.—*Examiners Maintained in Touch with Developments.*—The examiners themselves are kept fully informed of current developments by personal contacts with members of other branches of the Ministry and of the War Office and also by periodic visits to research and other outside establishments. Examiners also arrange, when possible, to be present at trials of new equipment connected with subjects dealt with by the examiner.

J.—*Contacts with Outside Bodies.*—Close contacts are maintained with outside bodies, for example, with committees of learned societies, who are informed of Service requirements in so far as these can be defined and are also given some details of proposals of a general nature which have already been investigated and found, in the absence of satisfactory or novel design details, not to be suitable for adoption.

K.—*Dissemination of Knowledge of Proposals.*—Every month a list is prepared of all the proposals judged to have merit, this list, which includes a brief *précis* of the subject-matter of each proposal, being circulated for information to the branches and establishments of the Ministry and the War Office,



Directorate of Scientific Research.—Invention Submission from September, 1939, to June, 1941

Month.	Monthly total.	Cumulative totals.	Month.	Monthly total.	Cumulative totals.
1939.			1940.		
Sept.	1,298	—	Aug.	2,231	29,111
Oct.	1,570	2,868	Sept.	2,071	31,182
Nov.	2,041	4,909	Oct.	3,690	34,872
Dec.	1,194	6,103	Nov.	2,539	37,411
1940.			Dec.	3,232	40,643
Jan.	1,467	7,570	1941.		
Feb.	1,800	9.370	Jan.	2,721	43,364
Mch.	1,257	10,627	Feb.	1,573	44,937
Apr.	1,504	12,131	Mch.	1,390	46,327
May	4,109	16,240	Apr.	1,143	47,470
June	6,910	23,150	May	1,613	49,083
July	3,730	26,880	June	1,271	50,354

For comparison with attached figures in above table.

Number of Suggestions Received by the Directorate when it was a Department of the War Office During Years

1935	1370
1936	1772
1937	2416
1938	3609
1939	2801 to 31.8.39

SUBMISSION OF INVENTIONS

to the Scientific Research Departments of the Admiralty and the Ministry of Aircraft Production, to the Ministry of Home Security and to the Department of Scientific and Industrial Research. Thus such proposals are brought to the notice of specialists who may find a possible application of a proposal not appreciated by an examiner.

L.—*Extra-mural Research.*—The Directorate itself has facilities for initiating research work, for example, in co-operation with the research departments of universities, and where it is considered desirable, arranges directly under its own control for research on and the development of a useful proposal.

M.—*Records.*—Records are kept of each proposal and proposer in card indexes in order to ensure that the priority rights of the true and first proposer of an adopted invention are preserved irrespective of whether or not the inventor has himself applied for patent protection.

N.—*Pending Patent Applications.*—In the case of a patent application which has been brought to notice either by the inventors themselves or through the Patent Office, copies of the provisional and complete specifications are examined, not only to determine whether the invention is suitable for Service use, but also whether publication of the specification should be prohibited under the Defence Regulations in order to prevent details of the inventions reaching the enemy. It may sometimes be necessary to prohibit publication of the specification of an invention which is not taken up because the invention is similar to one which is already in use. The examiners, in addition to scientific and technical experience, have the legal knowledge and in many cases the experience to deal with problems arising under the Patent and Emergency Acts and the Defence Regulations.

SPECIFIC PROCEDURE

Various lines of procedure are called for during examination, of which the following examples may be of interest :—

1. *Rejected Proposals.*—Many suggestions are received for filling anti-aircraft shells with ink, tar or analogous substances, which, when the shell bursts, will cover the pilot's windscreen and thus blind him. For this to happen at all the shell would have to burst very near to the windscreen, and thus it is preferable for the shell to contain high explosive and thus effect lethal damage. Most large aircraft such as bombers are fitted with blind flying equipment, so that the pilot could get home even if his windscreen were to be blacked out.

2. *Proposals Originally Rejected, but Action Taken by an Examiner to Cause Reconsideration.*

(*a*) A smoke generator for protective smoke screens was submitted from abroad, but initially rejected on the ground that meteorological conditions in the originating country are different from those in this country. This was returned for reconsideration and sample generators were subsequently obtained from abroad. These generators proved on test to be better than existing equipment.

(*b*) A light smooth-bore ordnance was put forward and the inventor was at once introduced to the military advisers in the Ministry. The proposal was initially rejected mainly on the ground that there are in use much better weapons. In view, however, of the fact that the better weapons take much longer to produce, whereas the proposed ordnance together with its projectiles can be produced rapidly and in large numbers without diverting production capacity from the better weapons, adoption of the proposal was strongly pressed by the examiner and the military advisers, with the result that some thousands of pieces with their ammunition are now being produced.

(*c*) A light grenade thrower was put forward and initially rejected. Trials showed the weapon to be quite useful and adoption of the weapon was pressed. It was eventually rejected on the ground that another weapon for the same purpose was already in production. The matter is, however, to be reconsidered should the numbers of the existing weapon prove on completion of the present order to be insufficient. In this case the examiner put up a design of charge which would meet one of the objections to the proposed weapon.

(*d*) A proposed modification of a Service wireless device was submitted by a serving soldier and rejected by the military advisers. The examiner, however, was not satisfied with grounds for rejection and returned the matter for reconsideration with arguments in support of the proposal. It was subsequently decided not to adopt the proposal on the ground that the wireless device in question was not a requirement.

(*e*) The use of china for a casting material for grenades was proposed and rejected, following tests, on the ground of brittleness. The examiner subsequently initiated inquiries into the possible use of china as a substitute material for other weapons.

3. *Proposals Submitted and of Interest, but Lapsing Owing to Lack of Interest by Original Proposer.*—A proposal for the purification of water was submitted by a firm, but as all subsequent attempts to obtain from the firm a demonstration of the process failed the matter was abandoned.

4. *Proposals of Merit which are Not Adopted Owing to Production Problems.*—Many constructions of machine gun are submitted for consideration, but a new machine gun, for adoption, must have very marked and not only slight advantages over existing guns, as the development of a new machine gun involves not only experiment in order to overcome the teething troubles of all such weapons, but also the design and manufacture of the necessary tools for mass production. Even if a new factory is being erected for machine gun production, a high rate of production is obtained much more quickly with a gun already in production than with a new gun. In several cases it has been necessary to inform inventors that a proposed machine gun does not show sufficient advantages over existing guns to warrant initiating production thereof during the war.

AWARDS, ROYALTIES AND APPEAL

A.—AWARDS

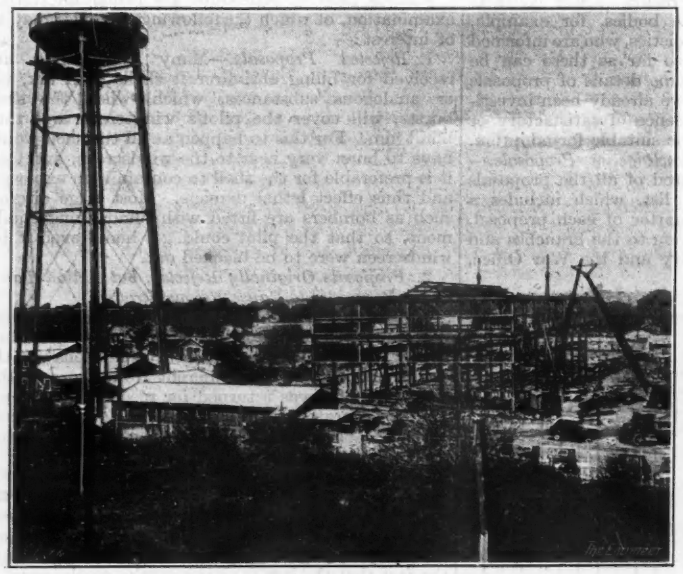
An award is a reward in respect of invention or proposal which has been adopted. There are two aspects :—(i) originality and value of proposal ; (ii) extent of use made. Of these (i) is clearly determined by technical merit and service to country in war or other effort ; and (ii) emerges clearly from records of production or application, obtained from Contracts and Production Departments.

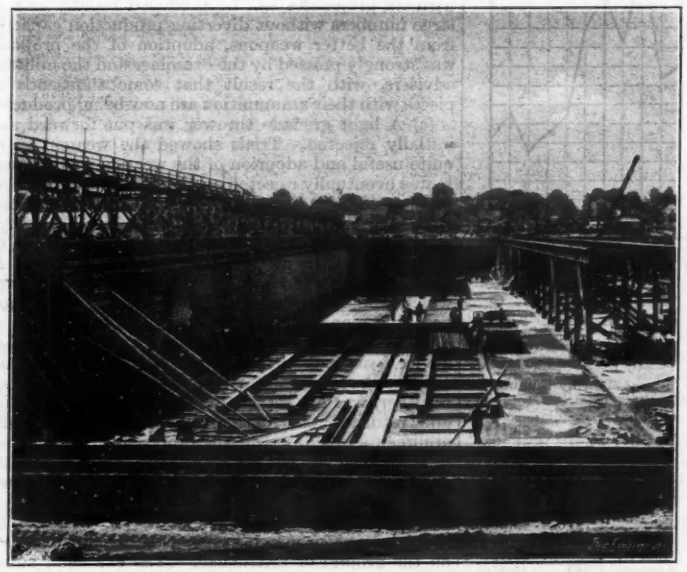
AUTHORITIES

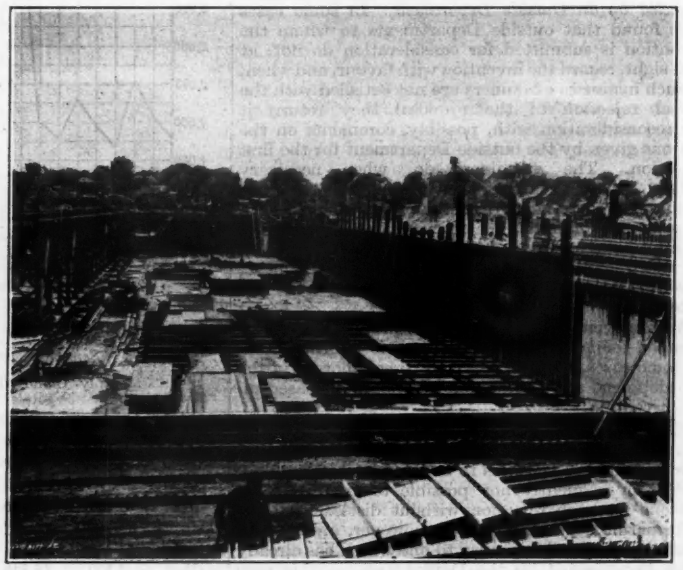
(*a*) *Ministry of Supply Committee on Awards to Inventors.*—Chairman, Dr. Gough ; representatives of (i) Ministry of Supply, (ii) Treasury, Admiralty and War Office.

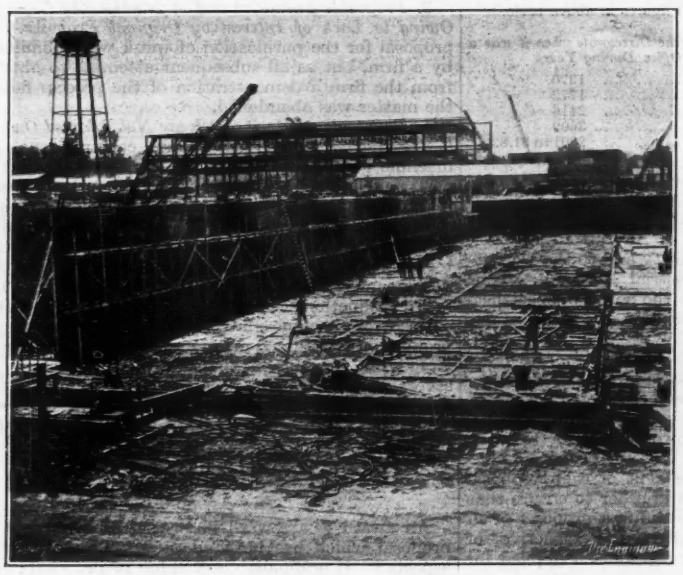
SOUTH PORTLAND SHIPYARD: CONSTRUCTION OF SHOPS AND BASINS

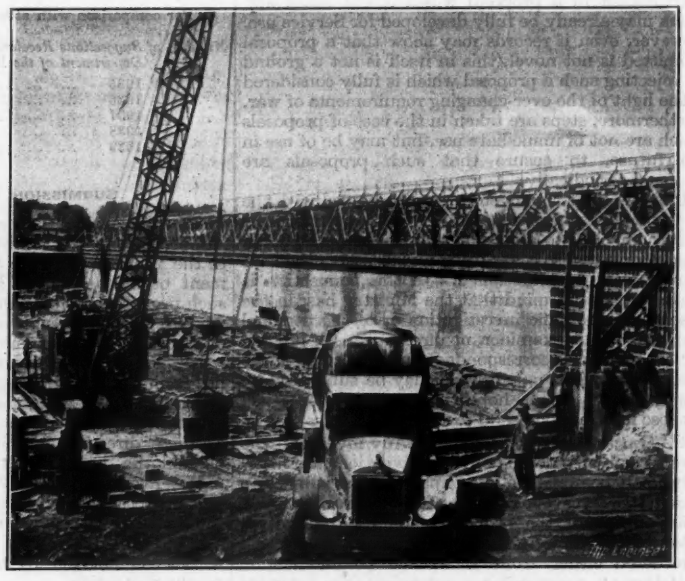
(*For description see opposite page*)











ERECTION OF PLATE SHOP

BUILDING BASIN NO. 1, BERTH NO. 2

BUILDING BASIN NO. 2, BERTH NO. 4

CONSTRUCTION OF SOUTH SIDE BASINS

BUILDING BASIN NO. 1, BERTH NO. 1

BUILDING BASIN NO. 2, BERTH NO. 3

(*b*) *Central Awards Committee.*—An inter-departmental Committee to which any dispute is referred. There is no record of any case having to be referred to this Committee, and as records extend back to last war, this is a most satisfactory tribute to relations existing with inventors.

B.—ROYALTIES

This is a matter for mutual arrangement between the Ministry of Supply and the owner of patent.

C.—APPEAL

If a dispute arises as to validity of a patent, the patentee always has the right to use the normal legal procedure; no case of this kind has arisen within recent years.

South Portland Shipyard, Maine

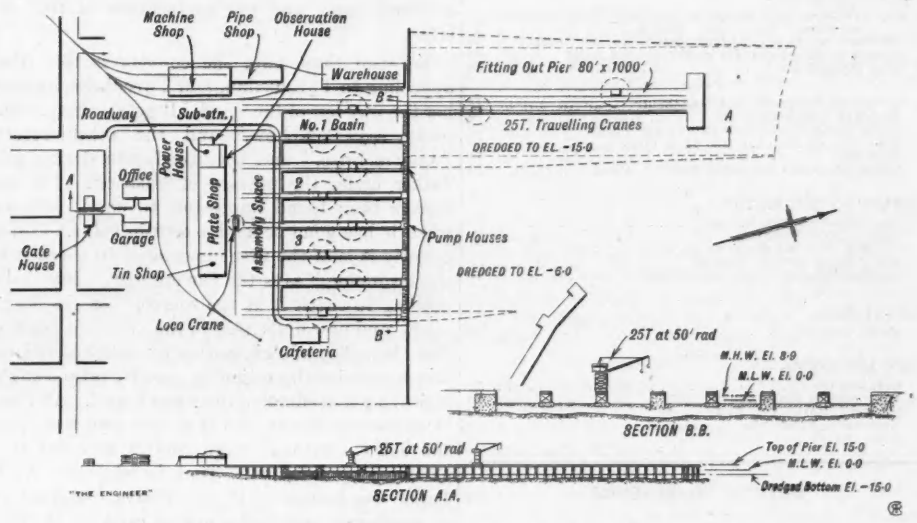
IN the article on new American shipyards which appeared in our issue of June 20th, we were able to reproduce an early photograph of the construction of the Todd-Bath Iron Shipbuilding Corporation shipyard at South Portland, Maine, where thirty cargo ships are now under construction for British war transport services. Although work was only begun early in January, such rapid progress has been recorded that to-day several keels have been laid, and all shipbuilding operations are well advanced. In the accompanying plan and engravings we give further particulars of the new yard.

When the building of cargo ships for British account was decided upon, the Todd Shipyards Corporation decided on the Portland site, which is not far from the works and yard of the Bath Iron Corporation, an associated undertaking, at which, we are given to understand, other shipbuilding operations are already in progress. The plan adopted differs from that usually employed in that the ships are being built in basins, the entrance to which is closed by a cofferdam. The lay-out of the new yard was entrusted to the Boston firm of Chas. T. Main, engineers, of 201, Devonshire Street, Boston, Mass., and preliminary plans were already drawn up in December, 1940. As will be seen from the accompanying illustrations, there are seven berths, which are arranged in three building basins. There are two berths in each of Nos. 1 and 2 basins, while No. 3 basin has three berths.

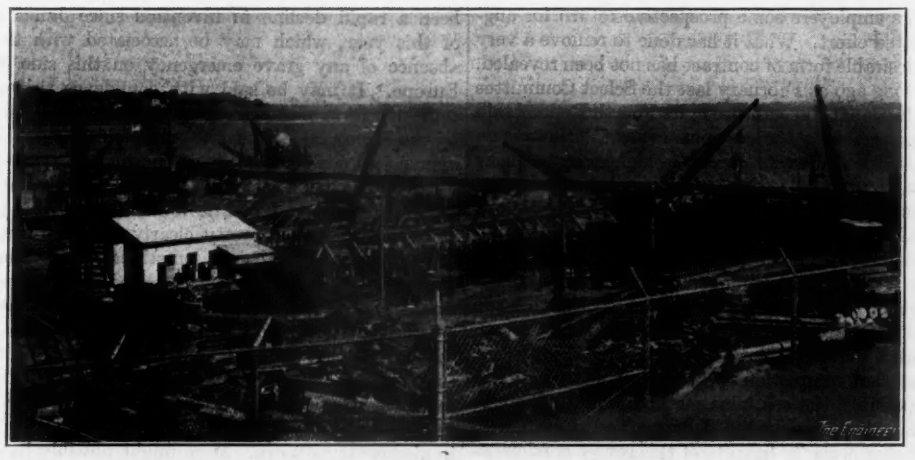
The yard lies practically north and south, and there is ample water for launching and fitting out. On the eastern side of the yard there is a breakwater, while on the western side a fitting-out pier has been constructed, having a length of 1000ft. and a width of 80ft. It has a tee-shaped head, 200ft. long and 75ft. wide. The pier is surrounded by deep water dredged to a depth of —15ft. The photographs reproduced herewith show clearly the various stages in construction, and the building of the bulkheads, the intermediate piers for the crane tracks serving the berths, and the pier. All travelling cranes are of standard design and they have a lifting capacity of 25 tons at a radius of 50ft. The lattice girder construction adopted for the crane piers and the nature of the sheet piling used in the construction of the three building basins will be seen from the photographs. The two sectional elevations accompanying the plan drawing show clearly the cofferdam and pier construction. It will be noted that there are three pumping houses along the cofferdam, in which the pumping plant for pumping out or filling the basins is installed.

The shipyard buildings are arranged on the same general lines as those for the Richmond yard, described in last week's issue, and only differ in details. Immediately behind the building basins there is an assembly area, for fabricated hull sections, which has a length of 723ft. and a width of 200ft. It is served by the cranes on the berth piers and also by a locomotive crane. At the back of the assembly area is the plate shop, which is 500ft. long and 100ft. wide. At one end of this shop is the sub-station for the electricity supply and the power-house, with an observation house looking over the yard. At the other end of the plate shop is the tinsmith's shop with a length of 75ft. and a width of 100ft. To the north of the plate shop there is a space reserved for the storage of plates, which has a length of 450ft. and a width of 85ft. In the front of the yard are the main offices, a gate house, and a garage with parking places for the motor-cars of the officials and the men, which are provided in and near the shipyard. The other shops on the west side of the yard include the machine shop, having a length of 225ft. and a width of 100ft. Adjoining the machine shop is the pipe shop, which is a building 200ft. long and 50ft. deep. A large warehouse, 300ft. long and having a width of 75ft., is provided.

The other buildings include a cafeteria, and a welding school with oxygen and acetylene generating plant for the school and the yard. Welding is freely employed in the construction of the hulls, and we learn from a report of June that at that date the school and its teaching equipment was so well advanced that at the beginning of the month of June about 300 trainees were already undergoing a course of welding instruction. A number of trainees have already passed through the training course, and are now employed on actual welding operations in the various stages of the assembly work and also aboard the ships.



PLAN AND SECTIONS OF SOUTH PORTLAND SHIPYARD



ASSEMBLY AREA FOR FABRICATION OPERATIONS

We may recall that the type of ship was decided upon by the Admiralty and the newly appointed Ministry of War Transport which was preceded by the Ministry of Shipping. The completed drawings were then sent on to America, where Messrs. Gibbs and Cox, naval architects of New York, collaborated in applying the design to American shipbuilding conditions. The principal dimensions given officially are as follows:—Length between perpendiculars, 416ft.; extreme breadth, 57ft.; and depth to shelter deck, 37ft. The deadweight carrying capacity will be about 10,000 tons, with a gross tonnage of round about 7000. The propelling machinery will comprise modern reciprocating steam engines taking steam from Scotch boilers fitted with superheaters. According to our American contemporary journal the *Pacific Marine Review*, quoted in our article on the Richmond yard last week, they will be triple-expansion engines with an output of about 2500 I.H.P., the speed of the ships being between 10 and 11 knots. The ships are being built under the Survey of Lloyd's Register of Shipping.

COURSES OF LECTURES IN FOREMANSHIP

ON Monday, July 28th, the Ministry of Labour and National Service announced that in conjunction with the Board of Education and the Scottish Education Department it is organising courses of lectures in foremanship at technical colleges in a considerable number of industrial areas. The establishment of a course in any particular locality will be dependent upon there being sufficient local demand. The lectures will cover the following subjects:—General Principles of Foremanship and Supervision, Principles of Production and Planning, Elements of Labour Management, Costing and Remuneration. The courses will be normally of seventy-two hours' duration and will usually be given in evening meetings of two hours each, held twice a week. Accordingly, no allowances or expenses will be paid by the Ministry to students. They will, however, not be charged any fees for the course. It is appreciated that both personality and considerable technical experience are required to make a foreman and that it is impossible to produce one simply by a course of lectures. The intention of the courses is to give the wider background which will be useful to men already possessing these qualifications. On this account only existing foremen and other men with the necessary experience will be accepted and only these should apply for admission to the courses. Employers are invited also to put forward men of the same type whom they consider will benefit from taking the course. Employers and workpeople interested in the scheme should get in touch with their local Employment Exchange. An examination will be held at the conclusion of each course. A written statement will be given by the technical college to those who pass it to the effect that they have attended the course and passed the examination successfully.

"FACTS ABOUT THE RIFLE."—In response to many requests, the two articles by Mr. David Weir, entitled "Facts About the Rifle," which appeared in our issues of May 16th and 23rd, 1941, have been reprinted in a handy form, which is now obtainable from the publishers, Morgan Brothers (Publishers), Ltd., 28, Essex Street, Strand, W.C.2, at 6d. per copy. We may remind our readers that the articles were written primarily for engineers who have joined the Home Guard, but they can be followed readily by any intelligent reader, and should—in this convenient form—appeal to thousands who desire to know more about the rifle than they can learn from an instructor.

A NATIONAL FAIR.—Comparable in a way with our own British Industries Fair is the Fair held annually in Göteborg, Sweden. That just concluded attracted 700 exhibitors, all showing Swedish products. Producer gas generated from charcoal or wood has become an important substitute for less available fuels, and the Fair showed various kinds of producer gas sets for automobiles, motor cycles, tractors, and motor boats, as well as for stationary motors. Wood and peat have also had to replace coal and coke, of which sufficient quantities cannot be imported, and new boilers and furnaces for these fuels are being developed by inventors and manufacturers.

SUBMARINES FOR SWEDEN.—The Swedish Navy received delivery of another submarine early in June from the Kockum shipyard of Malmo. The vessel is of the "Sjolejonet" type of about 600 tons, equipped with six torpedo tubes and two automatic guns, and has a surface speed of 16 knots. Several units of that type have been delivered to the Swedish Navy since the outbreak of the war, forming part of Sweden's extensive naval programme. The same shipyard has also launched two submarines, of which one was the first in a new series of small coastal submarines of about 400 tons, which Sweden at present is building. After completion of present construction, the Swedish submarine fleet will number about thirty modern vessels.

The Engineer

AUGUST 1, 1941

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Contents

THE ENGINEER, August 1st, 1941. PAGE

A SEVEN-DAY JOURNAL ... 65

LEADING ARTICLES—
WAGES AND WISDOM ... 72
WAR INVENTIONS AND INVENTORS ... 72

SPECIAL ARTICLES—
ESTIMATION OF THE RESTRIKING VOLTAGE CHARACTERISTICS OF SUPPLY NETWORKS. (Illus.) ... 75
HISTORIC ACCIDENTS AND DISASTERS. No. III. (Illus.) ... 66
SUPPLY OF TECHNICAL EQUIPMENT TO THE ARMY ... 67
WAR INVENTIONS ... 68

COURSE OF LECTURES IN FOREMANSHIP ... 71
POST-WAR RECONSTRUCTION ... 79
PRICE STABILISATION AND INDUSTRIAL POLICY ... 77
RECOVERY OF NATURAL GAS FROM COAL ... 78
RESEARCH ... 74
SOUTH PORTLAND SHIPYARD, MAINE. (Illus.) ... 71

LETTERS TO THE EDITOR—
THE BRAKE ON THE WHEELS ... 73
SHORTAGE OF ENGINEERS ... 73
"THE WORLD WE HOPE TO LIVE IN" ... 73
THE AKROYD STUART ENGINE ... 73
GOVERNMENT, INDUSTRY, AND LABOUR ... 73

LITERATURE—
SHORT NOTICES ... 74

NEWS AND NOTES—
CATALOGUES ... 79
FORTHCOMING ENGAGEMENTS ... 80
MARKETS, NOTES AND NEWS ... 79
NOTES AND MEMORANDA ... 80
SIXTY YEARS AGO ... 74

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CHANGES OF ADDRESS

**** Will Subscribers please note that in all advices regarding changes of address it is necessary to have* **both the old and new address,** *as our lists are kept alphabetically by towns. Advices of this nature should reach us by the first post Wednesday morning prior to the alteration.*

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WAGES AND WISDOM

"I was thinking," Alice said very politely, "which is the best way out of this wood. It's getting so dark. Would you tell me, please?"

But the fat little men only looked at each other and grinned.

LAST week the Government published a White Paper on "Price Stabilisation and Industrial Policy." It is reprinted in full on page 68 of this issue. Whilst it touches upon several subjects, the effect of wage increases upon the vicious spiral of inflation is the principal burden. When introducing his Budget this spring, the Chancellor of the Exchequer, after outlining his policy of price stabilisation, said: "I hope that we may thus create conditions which will enable the wages situation to be held about where it now is. It is clear that persistence of the tendency toward rising wage rates, which necessarily increases costs of production at every stage of the productive process, would compel abandonment of the stabilisation policy." That hope has not been, and is not being, fulfilled. Wages tend to increase and prices to rise; "these force a demand for increased wages, which is generally followed by a further increase in prices, and so on, indefinitely." That is a plain statement of a well-established fact. There can be no question about its truth. The converse is, manifestly, equally true. If wages fell, the cost of production would decline, and the real value of money would rise. No one would be any worse off than before. But inflation would be scotched. That course, advocated by a correspondent this week, is not a practical policy now. But whilst wages cannot be reduced, further increases of them ought to be checked. The mere suggestion that anything should be done to restrain them has, however, alarmed the T.U.C., which sees in certain words of the White Paper a danger that demands for increases may be rejected. Its General Council has gone so far as to declare that "any attempt to interfere with that system [the present system of wage negotiations] would undoubtedly cause undesirable repercussions, and would seriously impair national unity and the prosecution of the war effort."

Between these two, the country is like Alice appealing to Tweedledum and Tweedledee to show her the way out of the wood. It gets no help. One party says "Nohow," and the other retorts "Contrariwise," and the wood gets darker and darker under the menace of inflation. "It has always been found impossible to check inflation when it has gone beyond a certain stage. Consequently it is of the first importance to check it at the beginning," says the Government. But it did nothing to check it at the source, "at the beginning," and now finds itself in the awkward position that the policy of stabilisation by severe additional direct taxation, by rationing, and by price control, is proving less effective than was hoped. All these things are necessary, but it is now seen that, *pace* the T.U.C., without wage control included they cannot stop inflation. That is why the White Paper was issued. "It is," it says, "incumbent on employers and trades unions, with all the help the Government can give them, to do their best to prevent the costs of production from rising, from whatever cause." It is all very well to put the onus on employers and trades unions, but is not fair to either one or the other of them. The Government itself is responsible in the main for high costs and high wages. Early in the war it overthrew nearly all the established industrial methods and rejected accumulated experience. It put such a tax upon industry that it removed almost all incentive to economy, and it adopted in many instances a system of payment—the cost-plus—that made the incidence of wage costs of no account. In one respect it has seen the error of its ways. The deferred 20 per cent. concession on the E.P.T. offers employers some prospective return for augmented effort. What it has done to remove a very undesirable form of contract has not been revealed. As long ago as February last the Select Committee on National Expenditure in its Fourth Report, said with regard to the cost-plus system, "there is an incentive to waste, because higher costs bring greater profits," and it recommended that "cost-plus contracts should not be made for any work or product which is not novel in character, and should then only be made for the experimental phase," but it might be "condoned on grounds of extreme urgency" for "work which it is essential to begin and to complete within a matter of days." It concluded that: "Where the nature of the work is such that completion within a very short period is impossible, the cost-plus method is more likely to delay than to expedite delivery, and is certain to increase costs." In spite of this severe condemnation, it is believed that the cost-plus system is still largely employed. It suits the employer because it relieves him of the necessity to practise economy, it suits the employed because it removes the normal check on wage increases, and it suits the Civil Service. But since it manifestly tends to cause inflation, it would be a satisfaction to hear from the Government that it is being suppressed. Experience now having been gained, there is no longer reasonable cause for its continuance save in the rarest circumstances.

The objection of the T.U.C. to the White Paper centres round Clause 4, and the words: "The use of the experience and knowledge of workpeople is not less necessary than the application of managerial training and experience, and the maintenance of wages and employers' remuneration at a reasonable level should be achieved as far as possible by improvement in the efficiency of production by the joint efforts of employers and workpeople." In this laudable sentence Sir Walter Citrine sees a menace, for he believes that "applicants for higher wages will be required to show that output has actually increased, or that a commensurately greater output would result from an increase in wages." In other words, wages must not be required to bear any relation to the output, but solely to the requirements of labour. It means that the wage cost per piece may go up on demand; sound economy requires that the wages cost per piece shall fall, for then wages will be worth more, since commodities will be cheaper. It remains to be seen if the Government is stout enough to take any action in support of its own White Paper.

War Inventions and Inventors

UP and down the land there are thousands of disgruntled war inventors. They hold that they have been treated scurvily by the powers that be. They have sent precious ideas to the appropriate departments and have received no more than a postcard acknowledgement or a curt note turning their proposal down with little or no reason given. Each of them is convinced that he had *the* invention of the war and that no more was required than sympathetic consideration and a few experiments to bring it to wonderful fruition. But in place of encouragement he was told that he was but one in many thousands per week, or found himself classed with those whose inventions could be counted upon to raise a laugh. This was galling to all those who felt that it was their duty to the country to contribute their ideas for what they were worth and were inspired rather by the nation's needs than by lust of gain. We suspect that by far the greater number of war inventors are of that kind. They see a problem; a solution occurs to them and they hurry to send it off with no other thought at the time than that it may help their country in its need.

Inventions are the children of great emergencies. In the middle of last year the position of the Allies was extremely critical. Between May and August war inventions received by the Directorate of Scientific Research rose, as shown by a chart on another page, to a colossal peak. In August last the Battle of Britain began and after its failure night bombing became a regular occurrence. In the autumn months another, but much lower, peak was reached. Conversely there has been a rapid decline in invention since January of this year, which may be associated with the absence of any grave emergency on this side of Europe. It may be said with confidence that if some new form of attack should be suddenly sprung by the enemy on Britain the curve which is at the moment down to the mere normal of twelve hundred inventions a month will spring up again, perhaps to a new fantastic level. These sudden undulations indicate pretty clearly that war-time invention is in a sense emotional, and that gain is not the primary consideration of the great mass of inventors. For this reason if for no other it is desirable that the inventor should be treated with sympathy, patience and toleration. Unfortunately, he is all too frequently sadly lacking in technical knowledge and it is far too much to expect harassed departments to give to each and all lessons in elementary science. More might possibly have been done by little handbooks like that by Dr. Wimperis on "Defeating the Bomber," but there seemed to be a constant fear that the mere mention of problems would give useful ideas to the enemy, and the hush-hush policy was pushed to the limit of saying nothing at all for fear of saying too much. But it has at last been revealed that inventors were not, and are not, so badly treated after all. They do at least have a sympathetic hearing when they have anything even vaguely valuable to suggest. Last week Dr. Gough, Director of Research to the Ministry of Supply, spoke to the Press on the subject and circulated a Memorandum on "What Happens to Wartime Inventions," which we reprint with great pleasure this week. It is to be regretted that something of the kind was not done eighteen months ago; many heartburnings might have been avoided thereby. It records the manner in which proposals reach the Directorate of Research, how they are treated, and what happens

to them if they are accepted or rejected. It tells also of interviews with inventors, of the inspection of models, and various other matters. It is not an apologia for a Department which has been severely criticised by chagrined inventors, but a simple exposition of the course pursued by the Directorate with regard to inventions.

In a preliminary talk Dr. Gough stated that whilst no modern major war could be said to have been won by any particular invention, yet in the last war and in the present certain inventions have exercised a marked effect and the Ministry of Supply, recognising this fact, devotes a great deal of time, effort and money "to ensure that every inventor or proposer shall receive the most expert and sympathetic attention to his ideas." He distinguished between invention and research and development. The latter may lead to valuable inventions by laborious efforts, but occasionally a pure flash of genius or inspiration without any previous systematic thought or study may attain the desired end. Hence the Directorate has found it necessary to employ "special and very personal methods of dealing with the inventor and his proposal." Indeed, throughout his remarks, as in the Memorandum, it is made clear that within its limitations the Directorate is endeavouring to give all and sundry inventors a fair hearing and that by the means in its power it is making sure, and doubly sure, that no invention or proposal that has some prospect of success shall lack consideration.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

THE BRAKE ON THE WHEELS

SIR,—Ever since the beginning of the war it has been clear that it would be a war of machines more than of men.

The Government from the first emphasised the need for production and has never ceased to call for greater efforts in all directions.

After nearly two years of war it must have been a painful shock to many thinking people to hear it stated in the House of Commons by a member holding a responsible position that the productive effort of the country was only 75 per cent. of what it should be No one argued that the statement was incorrect, but many reasons for the low production were put forward by different people—all wide of the mark.

There must be many men in a position to know both the reason and the cure and it is amazing that they are silent. The Government at the start of the war were definite that fortunes should not be secured by some people while others suffered the miseries of war, and regulations to this effect were carried through with the approval of all.

Unfortunately, the regulations stopped short of the wages of munition workers, and when the Government supplemented the ordinary engineering industry by works controlled by themselves, wages out of all proportion to the amount of work done and to the skill of the men engaged were paid.

If the waste of money could have been confined to Government factories the harm would have ended there, but the reaction throughout, not only the engineering industry, but all industries, has been disastrous.

The average man employed in the engineering industry did not wish to sting his fellow citizens or to take advantage of his position as a skilled engineer; he wished to win the war, but the knowledge that sports professionals and many other classes of men new to industry were drawing wages double his earnings started a series of demands which must strain the financial resources of the country.

More serious even than this aspect is that instead of having a quiet mind fixed on work and output there is a considerable portion of the labour army concentrating only on pay. Absenteeism is in great measure due to overpayment. The high unearned wages of many unskilled munition workers has set a standard and skilled engineers have become dissatisfied, not with their own earnings, but by comparison with the sums paid to less skilled men. Other industries, such as coal and agriculture, actually base their claims for advances on the amount of wages paid to munition workers.

How serious the perpetual question of applications for increased wages has become is known most painfully to every works manager.

In justice to staffs, regular engineering employees and the general public, to whom the war has meant grave reduction in income, the Government should be compelled to reduce wages with a strong hand in cases where they are not earned. An immediate jump in output would be the result.

Nor is there difficulty in finding a fair basis to go upon; in all trades, for men, women and juveniles there are standard wages already agreed upon by employers and employed or fixed by Trade Boards and further arrangements in some trades that where piecework is worked the prices must be such that a 25 per cent. increase on the base rates can be earned by an average man. A strict return to the agreed rates, the cutting down of inflated piece rates and cessation of Sunday work would cure many of the difficulties in the way of greater production existing at the present time and in addition would save the nation vast sums of money and clear away the source of grievance felt by the staffs and skilled men all over the country.

BLACK COUNTRY.

SHORTAGE OF ENGINEERS

SIR,—Recently much has been said and written about the "Shortage of Engineers." Is it a fact that the shortage is as acute as is generally supposed?

To my mind the shortage is largely artificial and is occasioned by the outworn precept followed by employers, that the successful candidate for a particular appointment must have spent almost the whole of his working life in the particular branch of engineering to which this appointment relates. At the same time, if the appointment is an executive one, the candidate must have had some years of experience in a responsible position in this particular branch, often before he is thirty years of age. The result? That employers are taking men away from each other and an artificial shortage arises! I am speaking of qualified engineers. Surely the dictum which requires that an engineer filling a particular appointment must be near-expert in the field embraced by the appointment should be broken down under the present circumstances, and engineers with 90 per cent. or even 80 per cent. of the qualifications required be appointed, rather than production be held up.

It is my opinion that within a few weeks the 90 per cent. or 80 per cent. engineer would become 100 per cent. efficient. This appears to be a necessary reform, without which the engineering industry cannot hope to expand sufficiently to cope with the ever-increasing output required of it.

FRED. J. POTTS.

Gloucester, July, 19th.

"THE WORLD WE HOPE TO LIVE IN"

SIR,—The letter under this heading from Mr. J. E. Tuke should be read with sympathy by all engineers who are accustomed to accepting responsibility for the results achieved by their work. For too long the bank fraternity have operated the financial system with an entire lack of responsibility to the general community for results, and it is encouraging to find that people such as Mr. Tuke realise this to be the case.

It would seem that if we are to avoid the chaos which followed the war of 1914–1918, largely as a result of the attempt by Finance to return to pre-war "normal," some such licensing method as that recommended by Mr. Tuke will have to be introduced. Despite destruction from the air, Great Britain will doubtless end the present war as it ended the last one, with greatly increased productive capacity. Unless people unite in demanding results of their politicians, and the politicians enforce the will of the people on all those who control finance, we are likely once more to undergo a similar attempt to make facts, *i.e.*, the industrial system as a whole, fit figures.

M. J. WATT.

London, July 28th.

SIR,—In adding my tribute, if I may, to the patient and masterly analysis by Lieut.-Colonel Kitson Clark, in his article "The World We Hope to Live In," of the alleged causes of failure of the scientific civilisation, I should like at the same time to voice a fear that my friend, Mr. J. E. Tuke, is a little over-optimistic. His solution of Treasury-licensed financiers liable to dismissal and replacement if they fail to secure a free flow of goods as fast as they are produced—much as retailers licensed by the Ministry of Food now are—overlooks that not all are yet as alive as he or, for that matter, the financier to the entirely subordinate *rôle* money really plays in the solution of the problem.

To me latterly the problem has taken on rather a fundamental form, being nothing less than the necessity for the world to decide whether the bounties of science are for use and consumption or for hiring out for use and consumption. The moment one grasps this fundamental issue it becomes obvious that the old way, from the consequences of which the whole world is now enduring the agonies of approaching dissolution, is the only way, if the blessings are for hiring out purposes primarily. None but war and big business are in a large enough way to hire such a prodigality of wealth.

FREDERICK SODDY.

Enstone, July 23rd.

THE AKROYD STUART ENGINE

SIR,—Upon reading through the interesting article in the issue of THE ENGINEER dated June 27th last, under the title of "On Inventions and Patents," we noted from the description which immediately precedes the first paragraph of column 3, page 417, the following:—

"Other inventions which, duly patented, have lapsed through non-payment of fees include some of the most important inventive steps made during the last century. They include . . . the pilot injection of Herbert Akroyd Stuart."

As you are aware, we were the sole makers of the original Akroyd Stuart engine and have developed it uninterruptedly up to the present time. We are, however, not aware of any patents bearing Akroyd Stuart's name, covering the basic idea of pilot injection so far as we understand that expression.

To avoid any misleading impression that may result from the use of the expression "pilot injection," as associated with Herbert Akroyd Stuart, we should be obliged to know precisely what the writer of the aforesaid article intended to convey by those words as regards inventions of Akroyd Stuart and the numbers of the patents which he states were lapsed through the non-payment of fees.

If the writer of the article concerned intended the expression "pilot injection" to cover the method of working employed in the Akroyd Stuart engine as originally made, in which the fuel oil is injected solidly into the combustion chamber while air is drawn into the cylinder, then we would point out that it would appear to us that such expression does not correctly describe that engine, as we understand "pilot injection" to mean the injection into the working chamber of an engine of a light or starting fuel oil to provide the necessary heat to enable it to operate on certain heavy and low-grade oils.

In any case the essential patents covering the Akroyd Stuart engine were in force for the full term of the grant and were not lapsed through the non-payment of fees. Of the original form of Akroyd Stuart engine many thousands were sold and put to use in all parts of the world. It may also be of interest to point out that one of Akroyd Stuart's principal patents, viz., No. 7146 of 1890, discloses the idea of injecting liquid fuel solidly into air compressed in the cylinder upon the compression stroke of the engine. That is the basic idea under which all modern compression ignition engines and so-called "Diesel" engines operate, and the patent pre-dates Diesel's earliest British patent by nearly two years.

RUSTON AND HORNSBY, LTD.,
A. R. BELLAMY, Director.

Lincoln, July 22nd.

GOVERNMENT, INDUSTRY AND LABOUR

SIR,—On the whole one can but agree with "An Industrialist" on his outspoken comments, especially if one tempers them by giving due consideration to the points made in your accompanying editorial. In one important matter, however, the employment of women, and particularly the employment of women in the machine tool trade, his remarks are not altogether fair to the employers. They should, in part at least, be addressed to the Government.

In the twenty years following the last war machine tool makers, both in this country and in America, experienced very great fluctuations in the demand for their products. There were peak demands in 1919, 1929, and immediately preceding the present war; there were disastrous slumps in 1921 and 1932, and the ratio of the variation in the general demand for machine tools in the best and worst years during that

period was of the order of twelve to one. Any industrialist can appreciate in some measure the almost insurmountable problems thereby imposed on managements, and it is not to be wondered that many machine tool makers went out of business, nor that there were many examples of companies which did not pay ordinary dividends for periods of ten years or more because, under such wide fluctuations of trade, any profits earned in a reasonable year were swallowed up in a bad one, or had to be used to make good a deficit previously created. In such circumstances money for the most essential capital expenditure is very difficult to find.

In recent years one or two machine tool companies have made large profits and paid large dividends, but if such cases are investigated it will be found that, even if no capital reorganisation has taken place since 1919, these dividends followed a long period of time when no dividends were paid and, if averaged, the overall return is low.

In general machine tool prices and therefore profits were kept low even in the better years, partly by strong competition between British competitors—there never has been any general price agreement amidst the industry—and latterly by heavily subsidised competition from the Continent also.

In the four years prior to the beginning of rearmament in 1935 the industry was experiencing bad slump conditions, and in the years immediately following—which are the years selected for assessment of liability to E.P.T.—most companies were still spending considerable sums of money in catching up with arrears of repairs and maintenance, with the result that the profits in these years were kept at a low figure. Since then large building extensions have been put in hand, considerable sums have been spent in plant, and great efforts have been made to keep pace with the abnormal wartime demand for machine tools.

For over twelve months the prices of machine tools have been controlled on what is, in fact, a very low basis; but, owing to the large increase in production made by most concerns, more profit than the E.P.T. standard is earned so there is little complaint, for there is no point under present circumstances in accumulating greater profits which would be entirely swallowed up by E.P.T. Nevertheless, the 100 per cent. standard constitutes a grave danger, both as a deterrent to taking any risks than can be avoided—and, as Mr. Churchill has clearly pointed out so often, war cannot be won without taking risks—and as the means by which money which could and should be used for the development of further production resources is withdrawn from the business. Further whatever the profit standard, the incidence of income tax at 10s. 0d. in the pound leaves much less money available than was available in the standard years, and if, in those years, that amount was insufficient for the developing needs of a company, then how much worse is the position to-day!

To-day those who make the greatest effort and run their plant to the utmost limit are faced with the prospect of possessing a completely worn-out plant at the end of the war without any cash reserves to help to replace it.

Many employers in this position are now faced with the demand that they should employ women in large numbers. Few engineering works, particularly among machine tool makers, normally employ women in their workshops. To employ women now, therefore, calls for the provision of lavatory and other accommodation which is not at present available. Such accommodation is expensive to provide, and many people willing to carry out the Government's recommendations to the hilt are unable to do so because, owing to the circumstances outlined above, they have not got the necessary capital to spend. Yet they have earned more than sufficient money, but it is taken off them again in taxation.

In answer to an official inquiry as to whether expenses incurred in the erection of lavatory accommodation, canteens, and other facilities primarily for women workers would be the subject of any relief in taxation obtainable because of such expenditure, the authorities stated that this is expenditure of a capital nature which cannot be charged against profits as a trading expense in relation to income tax relief. In the last war certain allowances were made in some cases on quite a generous scale. Section 15 of the Finance Bill now before the House of Commons provides for an allowance for capital depreciation, the broad effect of which is that if any loss is incurred by the erection of buildings, plant or machinery necessary for the war effort, and these prove not to be required at the end of the war, the loss may be the subject of some adjustment in taxation at a nebulous date in the future. What would be far more to the point is a Government instruction authorising some departmental arrangement to meet such capital charges, when properly incurred, as a war expense.

So long as the present circumstances continue we shall suffer in many places from a tardiness in the employment of women, the responsibility for which cannot fairly be charged against the employers concerned.

A Managing Director,
M.I. Mech. E., F.C.I.S., M.I.P.E.

Manchester, July 16th.

Research*

Recently a broad new fund of knowledge for all those interested in industrial research has become available with publication of "Research—A National Resource, II, Industrial Research," prepared by the National Research Council and transmitted to Congress by President Roosevelt with the statement, "the report presents a clear record of how successfully we have translated our old-time Yankee ingenuity for invention into American genius for research . . . and thus raised our standard of living, strengthened our defense and enriched our national life. . . ."

Data compiled during the survey indicate the magnitude and growing importance of industrial research; in 1940, 2200 industrial corporations maintained 3500 research laboratories, employing 70,000 workers, as many as in the petroleum refining industry, at a cost of some 300,000,000 dollars, more than the output of the radio and phonograph industry. Between 1920 and 1940 industrial employment of research personnel rose, on the average, between 5 and 10 per cent. each year and employment in 1940 was some 20 per cent. above the comparable figure for 1938. Simultaneously with the survey the National Research Council prepared and has published a new edition of its directory, "Industrial Research Laboratories of the United States," with data for 1940.

As one unassailable stronghold of handicraft and individual effort, research is vitally dependent on effective personnel selection and a chapter of the survey is devoted to discussion of the necessary qualities. Particular emphasis is directed toward personal qualities of the prospective employee, as distinguished from technical ability, which can usually be determined from scholastic and other factual records. Characteristics such as creative urge, receptiveness to new ideas, and intellectual integrity—the ability and willingness to recognise and act upon the implications of facts—are particularly important in the personnel of a department which has so large a part in determining the direction and extent of a company's growth. The ability to plan effectively is perhaps more necessary in the junior members of a research organisation than in most comparable functions. The survey suggests the value of occasionally reviewing a research project on its completion to determine the amount of time necessary for its execution if none but useful experiments had been undertaken. Usually this is such a small fraction of the time actually spent as to provide a strong incentive for careful planning in the future.

Research expenditures for large companies are roughly proportional to sales within a given industry. Although the statistical data do not justify averages, individual cases suggest that in the small company, one with sales under perhaps 500,000 dollars, the research laboratory, if one is maintained at all, usually has six to ten workers regardless of company size. Thus research is proportionately more important to small companies which maintain laboratories than to most larger ones. That it is an invaluable competitive weapon is indicated by the results of interviews with officials of fifty small companies maintaining laboratories. Thirty-five stated that discontinuance of research would seriously injure their competitive position within three years or less. The small company need not be limited by inability to make a large investment in research facilities. The facilities of trade associations, research institutes and commercial laboratories are available and have long been used by both large and small companies. By this means the small company can conduct even fundamental research programmes, such as have proved successful in so many instances for larger corporations.

Basic to all other decisions which management makes on research is that on how much money to spend. As industrial research becomes increasingly divorced from the solution of specific pressing problems, this decision becomes more and more abstract. The survey found no standard practice in determining the amount to be spent for research; yet within specific industries the proportion of gross income devoted to research was surprisingly similar for different companies. Between industries, however, the rate of expenditure for research varied more widely than seemed explicable by differences in the opportunities for technological improvement. Research expenditures, in relation to magnitude of operations, of the rubber, chemical and electrical industries are over twenty times those of the food, forest products, textile and leather industries. Yet the rate of establishment of new laboratories, even in those industries spending least for research, has declined markedly since 1930; virtually all of the unusually large growth in use of research in 1938 to 1940 took place in existing laboratories.

The food industry, where remarkable advances have already taken place in recent years, is in particular mentioned as a fertile field for extension of fundamental research. The survey also suggests co-operative research by labour and industry in the now almost untouched field of fatigue and related matters. The rapid growth of research employment, the relatively small research expenditures in many industries, and many obvious current opportunities, all indicate that saturation of the demand for industrial research, even if theoretically possible, is immeasurably distant.

* From Little's *Industrial Bulletin*, June, 1941

Sixty Years Ago

The Explosibility of Coal Dust

The impression may prevail that the explosive property of finely divided coal dust is a discovery of fairly recent date. It is certainly true that we can read in our pages of sixty or seventy years ago accounts of colliery disasters, the details of which strongly point to coal dust having taken a very active part in them, although other causes were assigned to them at the time. Actually, the explosibility of coal dust was fully recognised, in some quarters at least, fully sixty years ago. In our issue of July 29th, 1881, we find a summary of a report prepared at the request of the Home Secretary, by Mr. F. A. Abel, Chemist to the War Department, on experiments made with samples of dust collected at Seaham Colliery. Mr. Abel's report set forth facts which have been fully confirmed by subsequent and perhaps more elaborate experiments, and which are now universally recognised. He found that coal dust actively promotes and extends explosions in mines by reason of its rapid inflammability and by the ease with which it could be raised and remain suspended in air currents. It could by itself burn fiercely and act as an explosive agent through the medium of a proportion of firedamp in the air of the mine, the existence of which in the absence of the dust would not be dangerous. Quite apart from its own inflammability, the dust, as a finely divided solid, could act to produce the ignition of a weak mixture of firedamp and air. In the entire absence of firedamp, coal dust, Mr. Abel found, exhibited a decided tendency to become inflamed, and to propagate flame if it were exposed to the effect of an explosion of gunpowder or gun-cotton, but its inflammation would not necessarily result in a violent explosion. On the other hand, the air of a mine in which the coal gave off any gas at all could not at any time be free from firedamp. Even if the amount of firedamp were so small as to make its existence unsuspected, its presence could result in the inflamed coal dust developing a violently explosive effect. Casualties as a consequence could occur in circumstances which might be held to be unaccountable from a study of the accumulation of firedamp by itself.

Literature

SHORT NOTICES

The Battle of the Seas. By Sir Archibald Hurd. London: Hodder and Stoughton. 1941.—This is the story of the fighting merchantmen by the historian of the part played by the Merchant Navy in the war of 1914–18. It opens with the statement that "We are witnessing the greatest struggle for the mastery of the seas of which history holds any record, and the merchant seamen are in the forefront of it, hazarding their all with fine courage, skill and resource." After this we need scarcely say that the volume is a tribute to the Merchant Navy, illuminated by many admirable illustrations, dramatic stories, and solid facts. It is a book for the general reader and ought to find its way on to many "parlour" tables. Turning over the pages, we came across a note about convoying—in which Sir Archibald is clearly a believer—which is worth repeating. We all remember convoying in the last war and have heard a great deal about it in the present war. But perhaps some of us had forgotten what an old practice it was and had never known the dimensions it attained in the past. We do not hear much about the size of convoys now, but presume that forty or fifty ships, protected by a few destroyers, would constitute a large one. But early in 1794 there is a record of a convoy of 600 sail covered by thirty-six line-of-battle-ships, and later in that year no less than 1000 ships were collected in the Belt and brought home safely by Admiral de Saumarez! It was protected by six ships of the line, six frigates and a number of sloops. Sir Archibald enjoys mixing history with current events and does so very effectively. If we are not wrong in assuming and hoping that the official historian of the Merchant Navy in the last war will also be the official historian of it in the present war, we may accept this book as an earnest of a greater work.

Estimation of the Restriking Voltage Characteristics of Supply Networks

By J. S. CLIFF, A.M.I.E.E.

WHEN only oil circuit breakers had to be considered problems concerning the rate of rise of restriking voltage of the supply network did not particularly interest the operating engineer, since tests in high-power laboratories had shown that the modern oil circuit breaker was capable of handling high rates of rise without difficulty, and further, its performance was not greatly affected over a wide range of rates of rise.[1] With the advent of the air blast circuit breaker, which in its original form was very susceptible to rates of rise, the problem of estimating the restriking characteristics of a given network became of general interest, especially to engineers who contemplated installing oilless circuit breakers. Although the subject has been studied intensively during the last decade by the specialists engaged on circuit

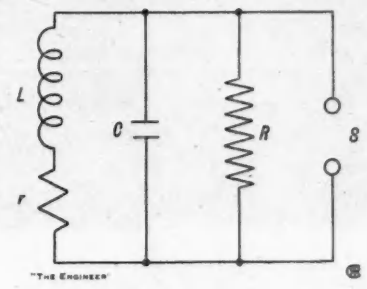

FIG. 1

breaker development, little general information has been published, so that the majority of supply engineers have only very vague ideas concerning the necessary calculations and measurements. It is the purpose of this article to outline very generally the methods and apparatus used in the estimation of the rate of rise of restriking voltage. References to more detailed articles are given at the end.

The inherent rate of rise is governed by the constants of the circuit. Fig. 1 shows the fundamental circuit consisting of a single-phase generator, the winding of which has an inductance L and resistance r and is shunted by a capacity C, R representing the leakage resistance.

The first point to be considered is the instantaneous value of the 50-cycle voltage. When the

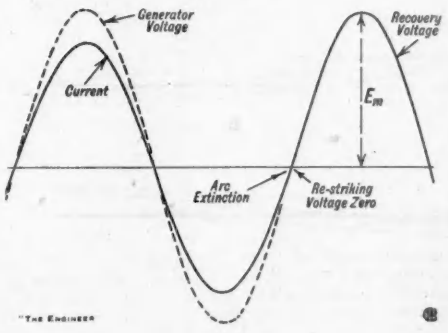

FIG. 2

short-circuit current is interrupted it usually takes place at a zero on the current wave, the instantaneous value of the 50-cycle voltage appearing across the circuit breaker contacts therefore depends upon the displacement between the current and generator voltage waves. This displacement is dependent upon the circuit power factor and the D.C. component of the current wave. If the current wave is symmetrical and the power factor is unity (r is large compared with $2\pi f$ L), then the current zeros correspond with the voltage zeros and the instantaneous voltage across the contacts at interruption will be zero, as shown in Fig. 2. This condition may be approached when an earth fault current is limited by an earthing resistance.

If the power factor is zero then the current zeros correspond with the peaks of the voltage wave, so that the instantaneous voltage across the contacts at interruption will be a maximum, as shown in Fig. 3. Faults between two or more phases usually approach this condition. Between these two limiting cases the voltage will be proportional to the sine of the phase angle between the current and voltage :

$$e = E_m \sin \phi \quad . \quad . \quad . \quad . \quad (1)$$

where $$\phi = arc\ \tan \frac{2\pi f L}{r}.$$

The short-circuit power factor of most systems is usually very low, so that ϕ approaches 90 deg., making e nearly equal to E_m.

If the power factor is very low and owing to the high-speed operation of the circuit breaker the current is interrupted while there is still appreciable D.C. component, then the instantaneous value of the restriking voltage depends upon the percentage D.C. component, and also whether extinction occurs following a major or minor loop of current. The displacement caused by the magnitude of the D.C. component is given by

$$\theta = arc \sin \frac{P}{100} \quad . \quad . \quad . \quad . \quad (2)$$

where P = per cent. D.C. measured on the last half cycle of arcing

$$= \frac{Y \times 100}{X}$$

When arcing ceases at the end of a minor current loop the angle θ_1 must be subtracted from the angle ϕ caused by the power factor, and when arcing ceases at the end of a major current loop the

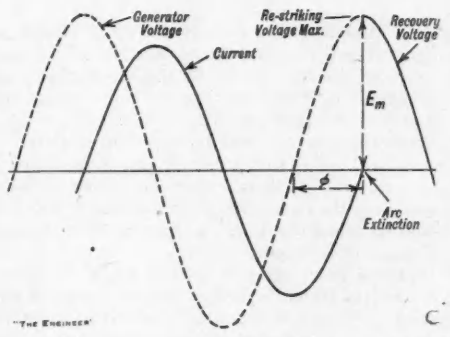

FIG. 3

angle θ_2 must be added to the angle ϕ. The complete equations are :—

$$e_1 = E_m \sin\left(\phi - arc\ \sin \frac{P}{100}\right) \text{ for a minor loop} \quad (3)$$

$$e_2 = E_m \sin\left(\phi + arc\ \sin \frac{P}{100}\right) \text{ for a major loop} \quad (4)$$

This is shown in Fig. 4.

Another factor which influences the instantaneous value of the 50-cycle component of the restriking voltage is the generator decrement. It is impossible in a short article to give details for estimating this accurately, but in general it depends upon the ratio of the short-circuit mVA to the normal output capacities of the generators supplying the fault. The greater the ratio the greater the decrement. In all cases, however, this factor reduces the voltage value ; hence, if it is neglected and no decrement assumed, a slight factor of safety will be provided.

The last important factors influencing the value of the 50-cycle component of voltage are the earthing of the system, and the type of fault. The worst case occurs on the first phase to clear of a three-phase fault when either the system neutral or the fault is earthed alone. In either of these cases the voltage is momentarily increased to 1·5 times the normal phase voltage, as shown in Fig. 5, until the other two phases clear.

The above points have been set out in some detail so that their relative effects upon the instantaneous value of the 50-cycle component may be judged. It is at once clear that all except the last factor tend to reduce the magnitude from the peak value of $\sqrt{2}$ times the R.M.S. value of the system voltage to neutral, so that since it is impossible to predict, say, the value of the D.C. component at arc extinction, or whether the last current loop will be a major or minor one, their effect should be neglected. Similarly with regard to system and fault earthing ; these cannot be foretold, so that the worst case giving 50 per cent. increase in voltage should be assumed. To sum up the instantaneous value of the 50-cycle component of the restriking voltage should be taken as

$$E_m = \frac{1{\cdot}5 \times \sqrt{2} \times E}{\sqrt{3}} = 1{\cdot}23\ E \quad . \quad . \quad (5)$$

where E is the system line/line voltage.

This will give an estimated value slightly higher than the actual value obtaining under the most onerous operating conditions.

Superimposed upon the 50-cycle component

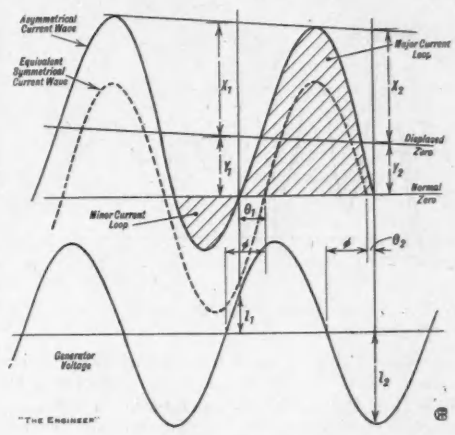

FIG. 4

is an high-frequency oscillation, the form of which is again controlled by the circuit constants shown in Fig. 1. The periodicity of this H.F. oscillation is usually large compared with the power frequency of 50 cycles, so that during the H.F. oscillation the instantaneous value of the 50-cycle component can be considered constant. It can be shown that the equation of the restriking voltage of the fundamental circuit shown in Fig. 1 (neglecting arc voltage) is

$$v = e\,(1 - \epsilon^{-\alpha t} \cos 2\pi f_2 t) \quad . \quad . \quad (6)$$

where ϵ = base of Naperian logarithms. This repre-

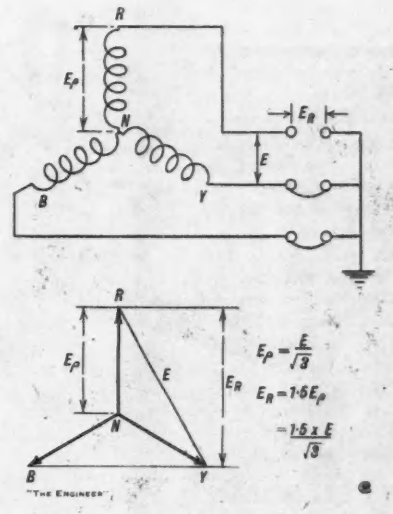

FIG. 5

sents a damped high-frequency transient oscillating about a mean value of e, as shown in Fig. 6.

The damping factor $\alpha = \frac{1}{2RC}$

and

$$f_2 = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \left(\frac{1}{2RC}\right)^2}$$

The peak value of this wave is

$$v_p = e\,(1 + \epsilon^{-\beta}) \quad . \quad . \quad . \quad (7)$$

where $\beta = \frac{\pi}{\sqrt{\frac{4R^2C}{L} - 1}}$.

If the rate of rise is to be expressed as the average slope, then

$$R_a = \frac{v_p}{t} \text{ volts per micro-second} \quad . \quad . \quad (8)$$

or, as it is more usually expressed, in terms of tangential slope,

$$R_t = \frac{1 \cdot 14\, v_p}{t} \text{ volts per micro-second.} \quad (9)$$

where t=time to reach peak value in milliseconds $=\frac{1}{2 f_2}$, f_2 being measured in kilocycles/second.

In practice even a comparatively simple network consists of several fundamental circuits, such as shown in Fig. 1. These can often be split up and each treated separately with the voltage which is associated with it, the final restriking voltage wave being the sum of the various individual transients. The main problem in estimating the rate of rise

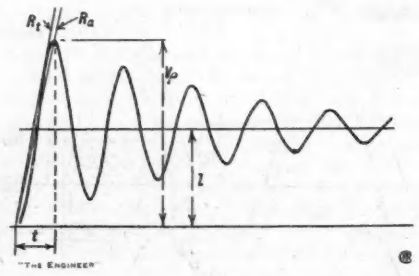

FIG. 6

by calculations is to determine the appropriate values for L, C and R. For the inductance the 50-cycle value can be used as a basis. The leakage reactances of generators, transformers and reactors are usually known, and the inductances of cables and overhead lines can be obtained fairly readily. Where there are iron circuits adjacent to the windings, such as in generators or transformers, or earth screens such as in cables, the value of inductance at the frequencies associated with restriking voltage transients will not be the same as the 50-cycle value, in general being slightly less, so that the rates of rise calculated with 50-cycle values are usually slightly low.[2, 3]

When the individual pieces of apparatus can be isolated the inductances can be measured with a portable A.C. bridge.[4] In these instruments the operating voltage is usually obtained from a

FIG. 7—ARRANGEMENT OF PORTABLE INSTRUMENTS

built-in generator which has a frequency of the order of 1000 cycles per second, so that the values measured by this means will be nearer to the correct value for rate of rise calculation than the 50-cycle value.

The assessment of the correct value for the capacity C is even more difficult, since the capacities to earth of such components as generators, transformers and reactors are not usually known and cannot be calculated unless full design particulars are available.

The easiest method of finding the values of the individual capacities is to measure them with a portable A.C. bridge, the capacity to earth being the most important value required. It should be noted that equation (6) is only strictly correct where the parameters are lumped. In practice the capacities of generators, transformers, overhead lines and cables are distributed along their inductances, so that the factor $\frac{1}{2\pi}$ is not correct, but may be nearer to $\frac{1}{3}$ or $\frac{1}{4}$ depending upon earthing conditions if there is no lumped capacity. The problem should then be solved by the application of travelling wave theory, details of which are too involved for discussion in a short article.[5] The usual arrangement of supply network, however, consists of both distributed and lumped forms of capacity ; if the latter preponderates then equation (6) will give a fairly good estimate.

It is nearly always impossible to obtain a value for R, since this is provided by the dielectric losses of the system insulation at the frequency of the restriking oscillation. In any case unless the frequency is very high (more than 20 kilocycles per second), the damping is usually not more than 10–15 per cent., so that the simplest treatment is to ignore R and reduce the result by 10 per cent. If R is omitted, then f_2 of equation (6) becomes

$$f_2 = \frac{1}{2\pi\sqrt{LC}} \quad . \quad . \quad . \quad . \quad (10)$$

which is the equation of an inductance oscillating with a lumped capacity.

If there is any load left in parallel with the

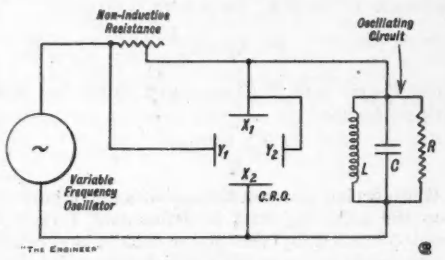

FIG. 8

system after the clearance of the short circuit, it will appreciably damp the oscillation. This can be allowed for by converting the kilowatts to an equivalent resistance per phase and using this value for R in equation (6).

From the above it will be appreciated that the accuracy of calculated rates of rise depends very largely upon the skill and experience of the operator in assessing the circuit parameters, and, in general, should be relied upon only to give an approximate indication of restriking rates.

Where a more accurate estimation is required, it is essential to make further measurements on the system. The first methods to be described are made at low voltage and current, and entail making the apparatus dead while the measurements are carried out. It is usually impossible to shut down a complete network, but by taking advantage of spare generators, transformers, duplicate bus-bars, and feeders it is often possible to treat the system in sections, and from the data so obtained draw fairly accurate conclusions for the system as a whole.

Inspection of equations (6) to (9) shows that the most important value to be found is that of the frequency of the transient oscillation associated with L and C. One of the easiest methods of measuring this is to apply a low voltage of variable frequency to the system and observe when resonance occurs. The frequency range to be covered varies from a few hundred cycles up to 200 kilocycles per second. Portable variable frequency valve oscillators having outputs of about 1–2 watts at 50–100 volts are quite suitable for this work. It is better to use two oscillators to cover the whole range up to 200 kilocycles, the first covering 0–12 kilocycles being of the beat frequency type, the second covering 10–200 kilocycles being of the ordinary oscillating valve type. The simplest method for detecting resonance of the system is to take the volt/ampere characteristics by means of a gas-focussed cathode ray oscillograph, a battery-operated model being very suitable, since by reducing the accelerating voltage the sensitivity can be increased so that a reasonable deflection can be obtained from the small voltage available. Fig. 7 shows a typical arrangement of portable

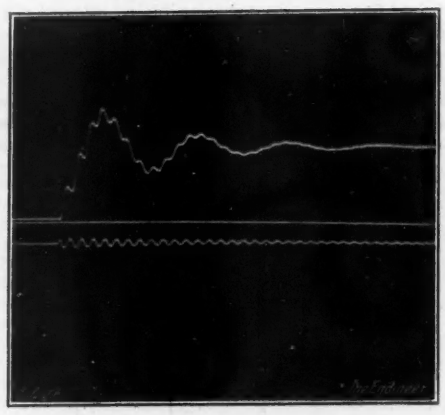

FIG. 9—OSCILLOGRAPH RECORD

instruments. The connections used are shown in Fig. 8, the X plates measuring the voltage across the circuit, while the Y plates measure the current passing through it. There is no need to take many readings, since at all frequencies, except resonance, there is a phase angle between the current and voltage, so that the C.R.O. record is an ellipse. At resonant frequency the two values are in phase, the record appearing as a straight line.

On most circuits several natural frequencies will be found. These may be caused by different sections of the network oscillating separately, or they may be the higher harmonics of one of the fundamental frequencies. This can usually be settled by sectionalising the circuit as much as possible. During the measurements the components of the circuit must be arranged as in service, *i.e.*, the primaries of transformers must be short-circuited, unless connected through to a generator, and conditions of earthing of system and fault must be observed. Where several sections of the circuit oscillate separately at different frequencies, the amount of the total restriking voltage associated with each is in proportion to its reactance.

Since this method automatically allows for the correct value of the L and C at the frequency of the transient oscillation, and also takes into account whether they are distributed or lumped, and whether earthing affects the travelling waves, the predictions can be fairly accurate in the hands of a skilled operator.

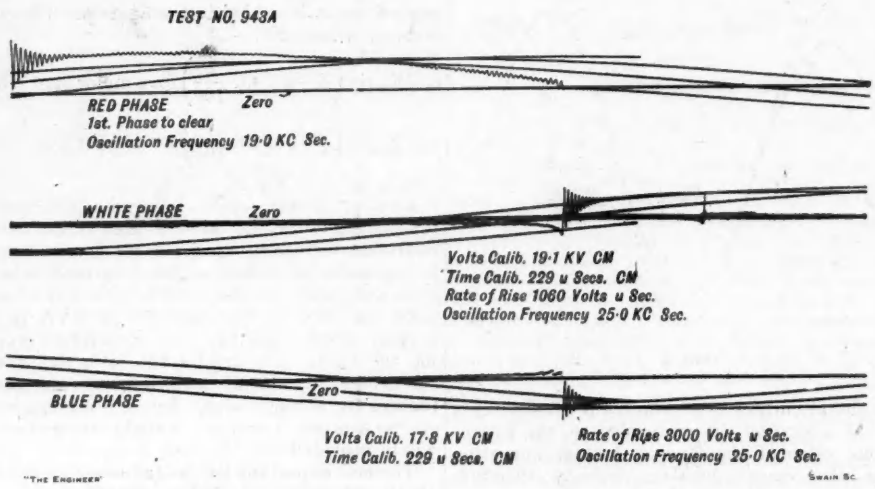

FIG. 10—TYPICAL THREE-PHASE RESTRIKING VOLTAGE OSCILLOGRAPH RECORD

Where a high degree of accuracy is desired, together with a rapid reproduction of results, then the restriking voltage indicator must be used, this again necessitating making the system dead.[6] Briefly, the instrument consists of a recurrent surge generator which injects a linearly rising current into the system fifty times per second. The voltage response to this surge is of the same form as the restriking voltage wave, and is observed on a glass cathode ray tube as a stationary image which can easily be photographed. Fig. 9 is a typical record involving two separate frequencies. From such records the rate of rise and peak value of the restriking voltage can very quickly be measured with a high degree of accuracy. Changes in the transient wave form caused by switching in different parts of the system can also be rapidly studied.

Where it is considered necessary to measure the rate of rise with the whole system connected, then usually it must be done with the circuits alive at full operating voltage. The first method for achieving this is to apply a short circuit to the

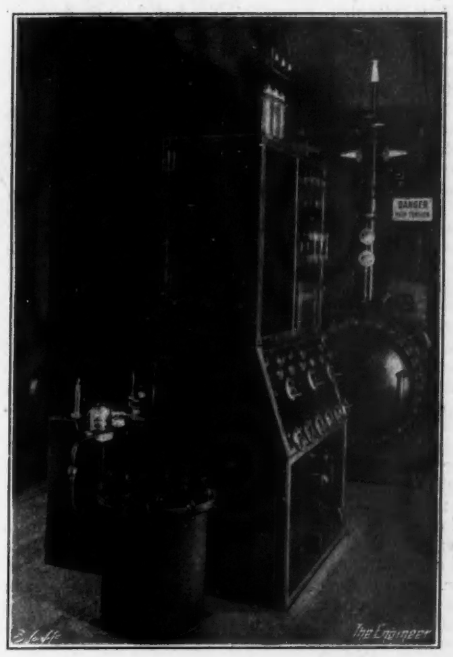

FIG. 11—THREE-PHASE OSCILLOGRAPH

system and record the restriking transient by means of a cathode ray oscillograph. This method has been successfully employed on several systems in this country and is by no means so hazardous an experiment as many supply engineers imagine.[7] The first requirement is a circuit breaker capable of reliably clearing the short circuit and having arc characteristics which will not unduly affect the restriking transient. Suitable circuit breakers, fully tested, are now available for all standard rupturing capacity ratings at any commercial voltage. To ensure the minimum interference with the inherent restriking transient of the ystem the circuit breaker should have a low value of final arc voltage and low arc gap conductivity immediately following current zero. Well-designed oil circuit breakers fitted with self-generated blast type arc control pots are quite suitable when operated within their rating. It has been found that placing an air core reactance in series with the system and short-circuit point, and measuring the rate of rise between the system and the reactor eliminates much of the interference of the circuit breaker with the restriking transient. The introduction of this extra reactance also reduces the short-circuit current value, and so eases the stress on the network.

For recording the restriking voltage wave a cathode ray oscillograph is essential. Several special oscillographs for this work have been developed, and they are extensively used in high-power testing laboratories.[8, 9] They consist essentially of continuously evacuated high-voltage cold cathode tubes fitted to a camera drum carrying a film within the vacuum, and rotated at speeds up to 6000 r.p.m., so that sufficient linear speed can be obtained to space out the transient oscillations to a readable distance, even for frequencies over 100 kilocycles per second. A typical three-phase record is shown in Fig. 10, this being taken on the three-phase oscillograph shown in Fig. 11, which also shows a single-phase instrument to the rear. While these instruments are necessary to obtain the records of high accuracy desirable in a research laboratory, it will be appreciated that they are somewhat large, and the operating technique complicated for successful adaption as portable instruments.

The first attempt to produce a portable cathode ray oscillograph suitable for general circuit-breaker research on supply networks was made by the E.R.A.,[10] which obviated many of the difficulties associated with the vacuum pumping equipment and loading the film into the vacuum by utilising sealed vacuum glass tube oscillographs, and photographing the record on the screen on to a film attached to a drum rotating at 3000 r.p.m. Records comparable with the continuously pumped oscillographs can be obtained at moderate natural frequencies with this instrument, and it has proved to be very useful in many important investigations.

Recent improvements in cathode ray tubes for television purposes have produced oscillographs which enable restriking voltage transients up to 50 kilocycles per second to be recorded with even simpler apparatus. Fig. 12 shows such an instrument, which can be easily made transportable. Instead of using a rotating film to obtain the time base, a scheme which is inherently complicated mechanically, owing to the high speeds necessary, the cathode ray spot itself is scanned back and forth across the screen by a saw-tooth wave, thus splitting each half cycle of power frequency voltage into a number of horizontal lines. The scanning speed is adjustable to suit the transient frequencies expected. A standard 6 cm. by 9 cm. camera, having a good lens of about f2 aperture can be

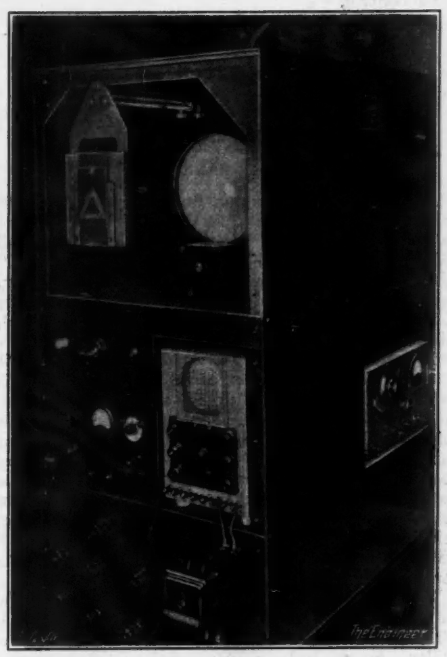

FIG. 12—OSCILLOGRAPH OF TRANSPORTABLE TYPE

used satisfactorily with ordinary high-speed orthochromatic films, although in the instrument shown a special camera of very simple construction has been fitted. By means of the modulator in the cathode ray tube the spot is withheld from the screen except for the few cycles during which the circuit is being broken, so that the shutter of the camera can be left open and automatically records (this particular instrument being used in a room which can be completely darkened). Fig. 13 shows a typical record of a fairly heavily damped transient. The 10 kilocycle per second timing wave is obtained from one of the valve oscillators shown in Fig. 7 and used for natural frequency measurements. As the record is reduced in size when photographed enlargement is usually necessary for accurate measurement.

Quite recently a further method has been developed for determining the restriking characteristics while the system is in service without the necessity of applying short circuits.[11] As in the restriking voltage indicator, a current, the rate of change of which is constant, is injected into the system. In this method the actual system voltage is used to generate the current surge, which is synchronised with the peak of the 50-cycle voltage wave and produces a superimposed oscillation which has the same form as the full restriking voltage transient. By means of a capacitance-inductance filter the 50-cycle component is cut out and the restriking transient alone recorded on the screen of a glass tube cathode ray oscillograph with sufficient brilliance to enable it to be photographed.

So far this apparatus has been used on systems up to 33 kV having short-circuit capacities up to 300 mVA. This range will undoubtedly be increased. Tests already made have proved its extreme usefulness, having demonstrated very clearly the effect of parallel cable networks and system load in lowering the rate of rise.

From the above brief descriptions it will be seen that apparatus is now available for studying the restriking characteristics of networks under almost any operating conditions, so that data can be compiled which will enable the characteristics of typical networks to be assessed. If, as in general the tests so far made have indicated, they are not so severe as was once imagined, it may assist the switchgear designers in producing less complicated and expensive oilless circuit breakers.

The apparatus shown in Figs. 7, 11 and 12 is

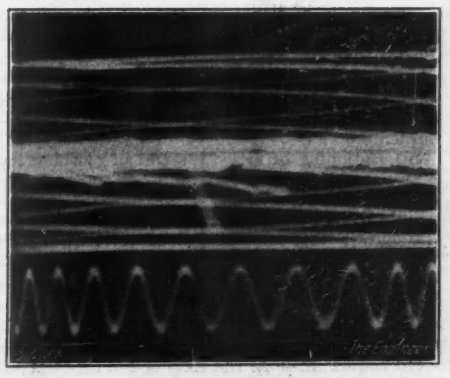

FIG. 13—OSCILLOGRAPH RECORD OF DAMPED TRANSIENT

the property of the General Electric Company, Ltd., Birmingham.

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Price Stabilisation and Industrial Policy*

1. THERE is evidence that the Government policy of stabilising prices, designed to avoid the evils of inflation, is not generally understood; it may be well, therefore, to re-state the considerations bearing upon this policy.

2. Our shipping difficulties and the diversion of man-power, machinery and factory space to the production of war materials have already greatly reduced the supply of goods for civilian consumption. The existence of stocks allowed some easement, but only for a time, and it is clear that not only must luxuries be cut out, but also there must be a reduction in the consumption of goods which in peacetime had almost come to be regarded as necessaries.

3. This curtailment is inevitable whatever money, wages, salaries or profits are paid out. Increases in wages or other incomes would not make more goods available. Such increases would not raise the general standard of living; they would merely tend to send up prices and to denude the shops, making it difficult to secure a fair distribution of the limited supply of goods. Those with the least amount of money or least able to spend time in shopping and standing in queues would suffer most.

4. The beginning of the "vicious circle" of

* White Paper, July, 1941. H.M. Stationery Office. Price 1d.

inflation is found in increased prices; these force a demand for increased wages which is generally followed by a further increase in prices and so on, indefinitely. It has always been found impossible to check inflation when it has gone beyond a certain stage. Consequently it is of the first importance to check it at the beginning. By creating insecurity and confusion it would impede our productive effort, give great opportunities to the profiteer and impose hardship on those who were not lucky enough to secure a share in the general advance of money incomes. People in receipt of old age pensions, insurance benefits or small fixed incomes would be able to buy less of the necessaries of life. At the same time the money costs of running the war would rise and the Government, unable to raise new taxes sufficiently quickly, would have to issue fresh money, which would further inflame the disease.

5. When the Chancellor of the Exchequer introduced his Budget this year, it was estimated that people would in 1941–42 have incomes amounting (after the deduction of taxation and saving at the then existing levels) to £500 millions in excess of the value of goods available for purchase.

To prevent this excess of spendable money leading to a rise in the prices of necessaries and to bring about an equitable distribution of the limited available supplies of consumers' goods, three main methods have been adopted :—

(i) Severe additional direct taxes have been imposed, which should have the effect of restricting the expenditure of those most able to bear the burden.

(ii) Rationing of foodstuffs and of clothing has been introduced to conserve supplies and to ensure a fair distribution.

(iii) A policy of price control has been adopted through the Prices of Goods Act, now extended by the Goods and Services (Price Control) Bill, through the exercise of direct price-fixing powers and through the grant of subsidies.

6. This policy of price stabilisation has recently been extended by the statement of the Chancellor of the Exchequer made at the time of the introduction of his Budget :—

"I propose to continue and extend the policy of stabilisation in an endeavour to prevent any further rise of the cost-of-living index number, apart from minor seasonal changes, above the present range of 125–130 in terms of the pre-war level."

The Chancellor explained that this policy of restricting increases in prices would also be extended to cover transport charges, the prices of coal and gas, electricity charges, and the prices of "other articles in common use." But it was made clear that the policy was necessarily dependent upon the following circumstances :—

"I hope that we may thus create conditions which will enable the wages situation to be held about where it now is. It is clear that persistence of the tendency toward rising wage-rates, which necessarily increases costs of production at every stage of the productive process, would compel abandonment of the stabilisation policy."

7. The Government believe that all parties in industry are alive to the dangers of inflation. It is incumbent on employers and trade unions, with all the help the Government can give them, to do their best to prevent the costs of production from rising, from whatever cause. A special responsibility falls upon managements to eliminate waste and to see that the organisation of work is such as to make the most effective and economic use of plant capacity. By the concessions in regard to Excess Profits Tax, the Government have endeavoured in the most effective way to provide an incentive to maximum development of productive capacity, and the urgent needs of the country make it a duty to increase efficiency of production to the utmost. The Government will take such steps as are possible to secure efficiency in establishments engaged on war production and the most effective use of labour resources.

8. It is regarded as the duty of both sides in industry to consider together all possible means of preventing the rise of costs of production and so to obviate rise of prices which is the initial step in the inflationary process. The use of the experience and knowledge of workpeople is not less necessary than the application of managerial training and experience, and the maintenance of wages and employers' remuneration at a reasonable level should be achieved as far as possible by improvement in the efficiency of production by the joint efforts of employers and workpeople. At the same time there may, consistently with these considerations, be proper grounds for adjustment of wages in certain cases, particularly among comparatively low-paid grades and categories of workers, or for adjustment owing to changes in the form, method or volume of production.

9. It is the traditional and well-tried practice of the principal industries to regulate wages through their joint voluntary machinery for wage negotiation. On the recommendation of the representatives of the Trades Union Congress General Council and the British Employers' Confederation on the Joint Consultative Committee and the National Joint Advisory Council, the Government decided to entrust the responsibility for wage regulation in wartime (save where machinery for statutory wage-fixing already existed) to the industrial joint machinery, subject only to the Conditions of Employment and National Arbitration Order, which was made with the concurrence of the Joint Consultative Committee and the National Joint Advisory Council and which provides for the more effective enforcement of agreed rates of wages, the reference of unsettled claims to arbitration and the prohibition of strikes and lock-outs.

10. Since the outbreak of war, the existing joint voluntary machinery for wage negotiations has operated successfully. Increases in wage rates have been reasonable; the authority of the unions in the day-to-day adjustment of wages and conditions has been maintained; the freedom of opportunity to make claims and to have them discussed has enabled industrial peace to be maintained.

11. The policy of the Government, therefore, is to avoid modification of the machinery for wage negotiations and to continue to leave the various voluntary organisations and wage tribunals free to reach their decisions in accordance with their estimate of the relevant facts. These will no doubt pay due regard to cases where there are special grounds for adjustment, such as those referred to in paragraph 8. If there were to be further increases in the cost of living this would need to be taken properly into account; but it is the object of the policy of price stabilisation to prevent such increases from arising, or at least to keep them within small dimensions, and the success of this policy will be dependent on the extent to which it achieves this object. It will therefore be necessary to bear in mind, particularly, when dealing with general wage applications, that the policy of price stabilisation will be made impossible and increases of wage rates will defeat their own object unless such increases are regulated in a manner that makes it possible to keep prices and inflationary tendencies under control.

The Recovery of Natural Gas from Coal*

By LEO RANNEY

When natural production from an eastern oilfield becomes no longer profitable, there is still left in the ground from 80 to 85 per cent. of the original oil content. That is worth recovering by "secondary" methods. When gas wells cease to produce naturally, the field is well gone, and only a very small percentage of the original gas is left in the pores of the sand, it is hardly worth trying to capture.

So natural gas is really a wasting asset. Since it is the most nearly perfect of all natural fuels, it is the most heavily drawn upon—and is the one fuel that will be missed more than any other when it is gone. In the East that day is not far off. Each year hundreds of eastern gas wells are being pulled and abandoned. A large percentage of the natural gas used in Ohio is imported from other States—and in Pennsylvania and New York natural gas lines are being filled with lower grade manufactured gas. To transport natural gas from Texas costs about 2 cents per 1000 cubic feet per 100 miles of transit.

We have been and are a wasteful people. In the old days the eastern oilfields were drilled only for oil. When gas was found it brought only curses from the driller. So gas wells were allowed to "flow open" for weeks and months on end, in the hope that they would "blow into oil"—which they often did. After a billion dollars' worth of this valuable fuel had been wasted, some dreamer got the idea that the gas might be saved. Now in the East, hardly a cubic foot of gas is allowed to waste from an oil well.

But to-day approximately 500 million cubic feet of natural gas is being wasted every twenty-four hours from our coal mines, mostly in the East, where it is badly needed. And whoever suggests its recovery and use is likely to be considered visionary or crazy. This natural gas is methane—the deadly fire-damp of the coal mines—with a heat value of 1000 B.Th.U. per cubic foot.

Some of the coal seams of Ohio, West Virginia, and Pennsylvania contain from 800 to 2000 cubic feet of methane per ton of coal in place. This gas is slowly exuded into the mine workings from the coal face. Some of our mines produce as much as 6 million cubic feet of methane per day, and the cost of ventilating such mines may exceed 10 cents per ton of coal mined. In one case 27 tons of air must be blown through the workings for each ton of coal produced.

During 1940 in the United States some 275 miners lost their lives in mine explosions. Because of just one mine explosion (from gas) in Ohio a few years ago, the Industrial Commission has paid to date well over a million dollars to the families of the men destroyed—and is still paying. This case is only one of dozens. Each year mineowners meet and spend days discussing better fans, better brattices, better methods of diluting the gas. But never a word about recovering the gas from coal in advance of mining operations. What would we think of the medical profession if their whole attention were absorbed in methods of treating disease—with not a thought given to removing the cause or killing the germ?

A careful study must lead to the conclusion that the greatest gasfields of the East exist in our coal deposits. In West Virginia a coal seam in one field contains upwards of two trillion cubic feet of sorbed methane—2000 cubic feet per ton of coal in place, and 22 million cubic feet per acre. This free gas adds nothing to the value of the coal, because it never reaches the market.

How can a ton of coal contain 2000 cubic feet of gas? Certainly not in the crevices and pores. It is held in the coal itself by intermolecular sorption. But methane (the wildest hydrocarbon gas) and solid carbon are so far apart in the scale that the equilibrium in which the methane is held is most unstable. The two are hard to "mix." It has been found that the most practical method of upsetting this equilibrium and releasing the gas is by a reduction of pressure—the application of a partial vacuum to the coal. Some mines have been known to increase their exudation of firedamp by a million cubic feet a day because of such an insignificant thing as a low barometer.

The main problem then is to distribute a vacuum into the body of coal to pull the gas out, through porous streaks, seams, "bleeders," and fissures. Research has indicated that the average bituminous coal seam is as permeable as the average gas sand, and that a high vacuum will pull methane through 400ft. of average coal.

The problem of distributing the vacuum has at last been solved by our ability to drill long horizontal holes—4000ft. to 5000ft. long in coal—and to control the elevation of the hole at any depth, to follow the contour of the coal seam. Such holes may be drilled from mine workings out into virgin coal, the holes being a mile long and being spaced about 800ft. apart. Each hole is cased at the mine end with 400ft. of pipe, grouted in. A high vacuum is then applied to the accessible end of the casing—which transforms each horizontal hole into a large gas well.

Neither during drilling or operating is any free gas allowed to enter the mine air. Drilling is done through stuffing-boxes, and vertical holes from the surface down to the horizontal well casings contain pipes to conduct the gas vertically to the surface of the ground. The vacuum pump is on the surface.

If we assume that a partial vacuum will pull gas through 400ft. of coal, on each side of a horizontal well there, a block of coal 800ft. wide is affected by each well—approximately 2 acres for each 100ft. of well length. Then a well 4000ft. long would drain gas from 80 acres. In some coal seams the influence of a vacuum would extend further, in others not so far. But if this may be considered average, then in our most gaseous coal seams a maximum of 1500 million cubic feet of gas would be drawn upon by each horizontal well.

No matter how desirable a humanitarian development may be, if it is an innovation that is to be widely adopted at once it should also promise a profit to the coal operators. The overall cost of producing gas from these horizontal wells in a gassy seam is estimated at 5 cents or less a thousand cubic feet. The selling price would vary from 15 to 25 cents a thousand, depending upon who the customer is. A recovery of 50 million cubic feet should more than liquidate the cost of each well, and the operating cost from then on should be about 2½ cents a thousand cubic feet.

The percentage of recovery of this free methane by the application of a vacuum must vary with the free gas content, and the permeability and solidity of the coal. In recently exposed coal faces in going mines, between 90 and 95 per cent. of the sorbed methane has vanished into the air of ventilation—without the application of a vacuum.

In ordinary mining and marketing operations, the gas is gone long before the coal reaches the furnaces. So the removal of methane from coal in place has no effect on market values. In the average coal it may be assumed that a vacuum will recover from 75 to 90 per cent. of the sorbed gas. Then degasification becomes directly profitable.

The indirect profit to the operator lies in the elimination of occasional ventilating shafts, reduced ventilation costs in future mining operations, reduced compensation insurance rates, reduced taxes, a smaller number of damage suits (after a major disaster these often total over a million dollars)—all because by degasification the coal may be made at least partially non-gaseous.

Of far greater importance to the householder, to industry, and to the State is the fact that the recovery of coal gas in advance of mining operations will release a new national asset of great value that was not known to exist—and will save the lives of thousands of miners during the years to come.

* From *Engineering Experiment Station News*, Ohio State University.

A Mine's Track Economy.—The use of welded mine track was considerably extended at various mines in the United States in 1940. Some mines use the thermit-welded main haulage track, while others favour the use of electrically welded mine track. The process, which consists of welding the rail together with fish plates in place, is standing the test of time. The approximate cost of 1 dollar per joint welded, makes the method attractive.

Post-War Reconstruction

IN the course of a speech which was made by Lord Reith, the Minister of Works and Buildings, in the House of Lords on Thursday, July 17th, some particulars were given of the interim report of the Uthwatt Committee on Compensation and Betterment. Lord Reith was able to state that the Government had accepted two of the major recommendations of the Committee referring to the amount of compensation to be paid and the work of reconstruction in war-damaged areas. It has been agreed that the maximum compensation to owners of land taken over for post-war reconstruction should be their value at March, 1939. It is further agreed that reconstruction areas, including areas of substantial devastation, should be planned as a whole, and that there should be adequate powers to acquire land, so that the planning schemes can be carried out effectively. With regard to the proposal that a Central Planning Authority should be set up immediately in order to work out a national plan, the opinion of the Government is that it is as yet too early to set up such an Authority in its final form. Lord Reith was, however, able to announce that a Council of Ministers has been set up and will act until the long-term policy of the Government in relation to reconstruction is more clearly defined. The members of the new Council will be Lord Reith, the Minister of Works and Buildings, who will act as Chairman; Mr. Ernest Brown, the Minister of Health; and Mr. T. Johnston, the Secretary for Scotland. In replying to questions which were raised during the debate, Lord Reith said that although he was a newcomer in politics, he could, as an engineer, judge foundations, particularly when he had a hand in laying them. He knew the difficulties which usually attended the clearing of the site. The work on the superstructure was to come. He would do his part and his colleagues would do theirs. The Government would do all it could so that the edifice might be broad and far and fair. The site was cleared, the foundations were laid, and it would not be grass that grew upon them.

Catalogues.

HOLOPHANE, Ltd., Elverton Street, S.W.1.—Booklet entitled "Why Glass?"

FERODO, Ltd., Chapel-en-le-Frith, Stockport.—1941 supplement to Catalogue 745.

GEORGE KENT, Ltd., Luton, Beds.—Leaflet No. 808/441, describing telerecorders.

G. AND J. WEIR, Ltd., Cathcart, Glasgow.—Catalogue describing the Weir optimum de-aerator.

TANGYES, Ltd., Cornwall Works, Birmingham.—Booklet No. 587 on factory heating stoves.

BENNIS COMBUSTION, Ltd., Little Hulton, Bolton.—Brochure describing a modern coking stoker.

OVERSEAS HANDICRAFTS, Ltd., 7–10, Mason's Place, E.C.1.—Catalogue of "Panda" engineers' tools.

NEGRETTI AND ZAMBRA, Ltd., 122, Regent Street, S.W.1.—Catalogue of automatic control instruments.

ILFORD, Ltd., Ilford.—Booklet on photography applied to plan copying in engineering and other industries.

WILD-BARFIELD ELECTRIC FURNACES, Ltd., Watford By-pass, Watford.—Leaflet describing Prestcold oil coolers.

METALLISATION, Ltd., Barclays Bank Chambers, Dudley.—Booklet on building up worn parts by metal spraying.

FOLLSAIN METALS, Ltd., Wycliffe Foundry, Lutterworth, near Rugby.—Catalogues of various metals and metal products.

STURTEVANT ENGINEERING COMPANY, Ltd., Rivet Works, Aylesbury.—Publication No. 1611 on laboratory machinery.

ENGLISH ELECTRIC COMPANY, Ltd., Stafford.—Leaflets Z10 and Z15 dealing with heavy-duty electric cooking equipment.

PHILIPS INDUSTRIAL, Century House, Shaftesbury Avenue, W.C.2.—Pamphlet on emergency lighting of shops and offices.

AMES CROSTA MILLS AND CO., Ltd., Moss Ironworks, Heywood, Lancs.—Leaflet on the "Simplette" sprinkler for sewage purification.

BRUCE PEEBLES AND CO., Ltd., Edinburgh.—Export trade pamphlet, No. 201, giving particulars of the firm's electrical plant manufactures.

BROADWAY ENGINEERING COMPANY, Ltd., Carlisle Road, Hendon, N.W.9.—Catalogue and leaflets dealing with Fitchburg grinding machines.

PLASTICS EXPORT GROUP, 11–12, Pall Mall, S.W.1.—Catalogue of British plastic products, printed in English, French, Spanish, and Portuguese.

FISHER DEANE ENGINEERING COMPANY, Ltd., 17, Victoria Street, S.W.1.—Illustrated booklet on the Nesfield Deane system of refuse utilisation.

LONDEX, Ltd., Anerley Works, 207, Anerley Road, S.E.20.—Leaflets dealing with relays, synchronous process timers, and the Londex roof-spotter system.

EDISON SWAN ELECTRIC COMPANY, Ltd., 155, Charing Cross Road, W.C.2.—Catalogue dealing with "Industra" reflectors and containing illumination data.

MONOMETER MANUFACTURING COMPANY, Ltd., Green Lane, Braughing, Ware, Herts.—Booklet dealing with the latest design of "Monometer" melting furnace.

W. T. HENLEY'S TELEGRAPH WORKS COMPANY, Ltd., Milton Court, Westcott, Dorking, Surrey.—Booklet on "Cold Filling Compound: Its Characteristics and Applications."

SELSON MACHINE TOOL COMPANY, Ltd., Abbey House, Victoria Street, S.W.1.—Leaflets on the Baush radial arm tapping machine and Jones vertical shaping machines.

WESTINGHOUSE BRAKE AND SIGNAL COMPANY, Ltd., Pew Hill House, Chippenham, Wilts.—Pamphlets No. 11H on "Metal Rectifiers for Telecommunications," and No. 11M on "The Static Auto-phase Converter."

Markets, Notes and News

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quantities are f.o.b. steamer

The United States Market

The pressure of consumers to obtain delivery from the steel works in the United States is increasing and in some districts the position is becoming tight. The works are using large quantities of pig iron and in some cases their demands have outrun the supply from the blast-furnaces. The call for foundry iron is also growing rapidly and a foundry in Pennsylvania with a daily capacity of 200 tons has recently been acquired by an ironfoundry interest which will absorb its whole output. Some scarcity has also developed in the scrap market, with the result that concern has been expressed and it is suggested that restrictions should be placed upon the export of this material. One railway company which normally offers for sale more than 20,000 tons of scrap has recently curtailed its sales to about 9000 tons. In May the consumption of steel scrap was 4,609,000 tons. No. 1 heavy melting steel scrap is quoted at 21 dollars and railway scrap at 22 dollars. In the Chicago district the scrap position has become tight and stocks are said to have been considerably reduced. Buying is on a heavy scale. The railways have ordered 8900 freight wagons as well as a number of steam and diesel electric locomotives. Pipe line construction is also much to the fore in the United States and large tonnages of plates will be required for natural gas and oil pipe lines. The rise in the demand for plates for pipe lines is said to be due in part to the conversion of tankers for use abroad. Amongst the inquiries which have been in circulation is one requiring 1500 miles of 20in. diameter, one for 2000 miles of 18in. diameter and one for 1000 miles of 16in. diameter pipe. The proposed extension of the plant of the Carnegie-Illinois Steel Corporation has been approved by the Government. This involves construction which will add about 400,000 tons per annum to the open-hearth and electric steel production. The output will be devoted chiefly to armour plate and specially treated steel forgings for the Navy and electric and alloy steels.

The Pig Iron Market

A steady stream of business is passing in the pig iron market, but such a large proportion of the allocations for the third quarter delivery have already been booked that there is a diminishing tendency noticeable so far as new business is concerned. Business in high-phosphoric pig iron has not been more than moderate, as the light castings industry is still working below capacity. The restriction on building has naturally reduced the demand for the products of this industry, and so far there has been no call for other products to offset the fall in demand in this direction. The hope that a considerable proportion of the plant in the light castings industry could be turned over to war work has only in part been fulfilled, since it has proved that the industry, generally speaking, was not furnished with plant suitable for manufacturing the products chiefly required by the Services. There is an exceptionally heavy call for low-phosphoric pig iron and hematite and great efforts are being made by the Control to conserve the supplies on hand. The production of foundry grades, although sufficient to meet all calls, is probably less than for a long time, since wherever possible foundries are concentrating upon the production of basic pig iron for the steel industry. The output of the latter class of iron is at a high level and although it is understood that imports in the future will be restricted, there seems no likelihood that any scarcity will develop in Great Britain. The tonnage of hematite going into consumption is being deliberately restricted by the Control, who are carefully supervising deliveries and concentrating upon keeping the firms engaged upon urgent war work supplied. Those firms who do not come within the high priority scale have in many cases to use substitutes, although it is suggested that later the position of hematite iron will become somewhat easier.

The North-East Coast and Yorkshire

Although the works on the North-East Coast are fully employed there are indications of a slackening in the demand for some products. This may be only of a temporary character, but in the case of heavy joists and structural material in which the falling-off in the demand is most noticeable the movement has been going on for some weeks. Whilst some of the constructional engineering firms are busy the majority are far less so than a year ago, and recently a number of important jobs have been completed without fresh contracts coming forward to replace them. Several of the works are now in a position to give relatively near delivery of orders and the majority of them have enough work on hand to keep them occupied for several weeks. The restriction on the imports of semi-finished steel has resulted in an increase in the demand for home-produced semis and the works turning out this material are experiencing considerable pressure from consumers. The most noticeable feature in the demand, however, is the steady and voracious demand for shipbuilding steel of all descriptions. The plate position is somewhat tight, as there is a heavy call for plates from the boiler-makers, wagon builders and tank makers, as well as the shipyards. The re-rolling industry, which for the most part has managed to accumulate some stocks, is kept busily engaged and is producing large tonnages of light sections and bars. All classes of bars, however, are in active request, especially from the engineering trades, and there is a sharp demand for bright-drawn steel bars. The munition makers are insistent in their request for special and alloy steels and the aircraft industry is taking up good tonnages of special steels required in the manufacture of aeroplanes. It is anticipated that the demand for special steels will expand and there are reports that the production of this class of material will be increased. The collieries continue to take good supplies of roofing bars and light arches. In the Yorkshire district all the works are producing at capacity and the insistent demand noticeable for so many weeks shows no signs of relaxing.

The Midlands and South Wales

The pressure for supplies for a number of descriptions of iron and steel appears to have passed its peak and the volume of new business coming forward shows some decline. This is particularly noticeable in the case of sheets, strip and some descriptions of bars. It is suggested that this is partly due to the large tonnages of imported materials which have been distributed. The actual consumption of steel materials, however, still remains on an extraordinarily heavy scale, and with the restrictions upon the importations of steel it seems likely that there will be a more rapid consumption of the available supplies and that users will have to rely for a time largely upon home production. There are, of course, no figures of production published, but these are known to the Steel Control, who are apparently satisfied with the output; and the recent census of steel stocks which was carried out under the direction of the Control should enable them to estimate the country's position so far as steel supplies are concerned with a fair amount of accuracy. Structural engineers are for the most part actively employed, although new contracts are not coming forward at the rate at which the old ones are being completed, and this is reflected in the quieter call for structural steel. It is chiefly evident in the demand for heavy joists and sections, and there has been a decline in this direction for some time. The volume of business in the lighter descriptions of structural steel and bars remains considerable and is sufficient to keep all the re-rollers operating practically at capacity. The quantities of billets available are sufficient to meet consumers' requirements, and in a number of cases a certain amount of stocks have been accumulated so that the re-rolling industry generally is in a better position than it has been for a long time. In South Wales the steel works are concentrating upon the production of essential war supplies. There is a satisfactory supply of raw materials and the works are able to maintain big outputs. In the case of a few descriptions of steel, particularly heavy structural steel, some of the works are able to book new business with the promise of fairly early delivery. Some improvement has taken place in the demand for sheet and tinplate bars, although the sheet works are finding the pressure for delivery from consumers less acute than a short time ago.

Copper and Tin

The British Non-ferrous Metal Control continues to keep a watchful eye upon the deliveries of copper to consumers, whilst demand is exceptionally large and comes principally from the war industries. All the firms engaged upon war work, however, are receiving full supplies and no concern is felt regarding the future; but it is obvious that it is only common sense to exercise reasonable care in distribution. A certain amount of copper is available for firms making exportable products, but copper for all commercial needs is not so easily secured. In the United States the copper position is rapidly becoming similar to that in Great Britain. In response to suggestions by the Government, dealings in copper futures have been suspended on the New York Commodity Exchange and all future positions are to be liquidated. The prices arranged for this process are:—July, August and September, 11·80c.; October, 11·65c.; and December and January, 11·55c. It will be remembered that a plan of this character was put into operation in this country after the outbreak of the war, and it seems evident that the control of the non-ferrous metal markets in the United States will be similar to that in force here. Whilst no maximum price has been legally enforced, however, the Government and the producers have agreed between them to maintain the figure at 12c. for some time past. With the closing of the Commodity Exchange the last source of information regarding the position in America, whether conditions are tight or otherwise, will probably disappear. It is suggested that the whole of the South American copper output will be taken up by the United States, but there are those who believe that the situation is not likely to become so stringent as is feared, especially as large quantities of copper scrap are likely to become available. . . . The tin market has grown firmer largely as a result of Japanese action in French Indo-China. This is regarded as a possible threat to supplies, and it brought out a fair amount of American buying. It was also reflected in the East and in London. The price in London rose to £261 for cash and it has been held at that figure. Whilst it was expected that Russia would be a considerable buyer of tin, so far there has been no sign of this, and it is pointed out that Russia may buy either through dealers in London or direct from Singapore.

Lead and Spelter

In Great Britain the lead position appears satisfactory. Not only is sufficient metal forthcoming to meet the full requirements of firms employed upon war work, but there is some surplus for firms engaged in less essential operations. Amongst the biggest consumers of lead are the battery and cable makers. Supplies, however, appear to be reaching this country with regularity and there is also a considerable accumulation of scrap lead. In the United States conditions seem to be getting rather tight, but so far as can be gathered there is no scarcity in supplies for the firms engaged in the defence programme. According to the American Bureau of Metal Statistics, the stocks of refined lead in the United States at the end of June were only 24,300 tons, or about 10,000 tons less than at the end of May. Production in June was also down at just over 48,000 tons, against 60,500 tons in the previous month. . . . The situation in the spelter market has not altered, and in most countries the position remains tight. It is, however, satisfactory that in Great Britain the supplies are adequate to meet the calls from the war industries, but there appears to be little surplus for firms employed upon ordinary commercial work. Naturally, the Control is carefully supervising distribution, but apparently no concern is felt as to the future.

Notes and Memoranda

Rail and Road

Road Haulage (Operations) Advisory Committee.—The Minister of War Transport has set up a Committee to advise him on the operation and development of the Government road haulage scheme. He has appointed Major G. A. Renwick to be Chairman of the Committee.

No Sleepers for Women.—Germany recently banned the sale of sleeping berths to women and children. Subsequently, the ban was lifted for certain express trains, but the restrictions are understood to remain on trains operating in or out of Berlin, all such berths being reserved for Army officers and other officials.

Tungsten in U.S.A.—A high-grade deposit of tungsten ore has been discovered jointly by engineers of the U.S. Bureau of Mines and geologist of the Geological Survey. This deposit lies in the Yellow Pine district, Idaho, a district well known for its antimonial gold ores, but not previously known to contain tungsten ores.

Big-scale Use of Producer Gas.—One of the best-known fleet of omnibuses in the East Midlands belongs to Barton Transport, Ltd., and operates on gas. Recently collated figures reveal that up to May of this year 25,000,000 cubic feet were used in running 500,000 miles. The importation of 75,000 gallons of petrol was thereby saved.

Mexico and Panama Road.—A plan is on foot to provide funds to complete the highway from the southern frontier of Mexico, 1550 miles to the Panama Canal. The total cost is estimated at 101 million dollars. The United States Government would finance up to two-thirds of the cost, with a maximum of 20 million dollars, extended over five years. The route is through six countries—Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, and Panama.

A Jubilee.—The U.S.A. Association of Private Owners of Railway Rolling Stock completed recently fifty years of activity. Its formation in 1891 resulted from a dispute with the railway companies, which had issued revised standard specifications for the repair and maintenance of private owners' wagons. These regulations were considered by the colliery owners and coal traders to be unduly stringent and, following a conference of private owners, the Association was formed.

Highway Progress in Canada.—Despite her participation in the war effort, Canada is pursuing a policy of extension in roads. By way of example, the highway programme for 1941 for the Province of British Columbia will disperse the work generally over many of the present roads in the province, and entail an estimated cost of 1¼ million dollars. The 1941 programme of highway work in Quebec Province will be a continuation of the three-year construction programme begun last year.

A Central American Amalgamation.—The Costa Rica Railway Company, Ltd., has acquired the whole of the share capital of the Northern Railway Company of Costa Rica, and from July 1st the lines have been operated as one system. The Costa Rica Railway Company, Ltd., owns 188 miles of 3ft. 6in. line, which, since 1905, has been worked by the Northern Railway Company as part of its total undertaking of 322 miles. The combined rolling stock comprises 37 Northern locomotives, 49 wagons, and 563 freight wagons, and 22 locomotives, 33 wagons, and 350 freight wagons of the Costa Rica Railway.

Grain Elevators Acquired.—The Argentine Government has taken possession of the Central Argentine Railway's grain elevators in the port of Buenos Aires, on the expiry of the forty-year concession, under which they were operated by the railway. Constructed in 1901, they have a capacity of 55,000 tons, half of which is for bags and the remainder for grain in bulk. They comprise five large sheds, a central elevator and equipment for loading six vessels simultaneously. They were the first elevators to be erected in Argentina, and constructed throughout of British materials, they are estimated to have still many years of usefulness.

Producer Gas Transport.—In reply to a question in the House of Lords, Lord Snell recently said that a great deal had been done by the Government to encourage gas producers and research was still being actively carried on. The Government had hoped that by the various forms of encouragement given gas producers might have developed commercially on a large scale, but for a variety of reasons that had not been the case. Encouraging progress had, however, been made with regard to the important technical problems involved, and there was reason to anticipate an advance in the number of gas producer vehicles in use in the comparatively near future.

Air and Water

Dutch East Indies Shipbuilding.—News has been recently received of the formation of a new shipbuilding company at Samarang, Netherlands East Indies, for the building of 10,000-ton steamers.

Canadian Aircraft Production.—Production of aircraft in Canada in the three months ended June 30th increased 25 per cent. over that in the preceding three months, and was ten times greater than the entire output of the year 1939.

Aluminium for Aircraft.—The U.S. Metals Reserve Company has purchased 170,000 metric tons of aluminium from Aluminium, Ltd., of Canada, deliveries to be made over the next three years. This duplicates an order in course of execution.

A New Plastic Process.—The increasing demand for plastic parts for aircraft production has led to the installation of a new plant in the works of the Monsanto Chemical Company, of Springfield, Mass. A notable feature of the plant is its provision for cooling and solidifying the resin formed in the reaction pans. The resin is poured on a steel floor which can be canted so that the molten material spreads over the entire area, thereby quickly cooling and hardening. The floor is air cooled from below. When solid, the resin is broken into lumps, and passed to the next stage of production.

Mississippi River Bridge.—A contract will shortly be awarded for taking soundings to determine the probable position of the proposed Mississippi River bridge, at Memphis, Tenn. Two points have been selected, one in north Memphis and the other beside the existing bridge. Tentative plans for the new bridge call for a structure to carry four or possibly six traffic lanes.

Preservation of Hangar Timber.—The construction of timber hangars in Canada at the training camps has led to the devising of treatment for fire and rot resistance. Zinc chloride, manufactured by Canadian Industries, Ltd., in Hamilton, is one that is favoured. The wooden trusses for the hangars are being impregnated with zinc chloride, holes being bored and incisions made to ensure an even penetration of all exposed surfaces.

Producer Gas for a Ferry Boat.—From the West Coast of Sweden comes the news that a Diesel engine on a ferry boat has been replaced by a six-cylinder high-speed engine using producer gas, which, however, is not quite an innovation. Producer gas for ships' propulsion has been shown on quite a number of occasions during the past thirty or forty years to be a practical proposition; a number of heavy tugs in Germany engaged on the Rhine service are operated by producer gas engines, using coke.

Todd Shipyards Corporation.—The Todd Shipyards Corporation celebrated the twenty-fifth anniversary of its incorporation on June 16th, and the *Journal of Commerce* has recently published some details of its development. The parent organisation of the present corporation goes back more than a century, but the organisation as now constituted was formed in 1916, after acquisition the year before of the Robins Dry Dock and Repair Company from the Clyde family. This corporation included approximately 100 men, who had been working with Mr. W. H. Todd, and the Clydes arranged that they would be given six years to pay off the purchase price. The purchase price was actually paid off in somewhat less than one-ninth of the time originally allotted. In June, 1916, with the fulfilment of the obligations of the William H. Todd Corporation, Mr. Todd saw the value and need of expanding the activities of his organisation. In order to acquire the plants and business of the Tietjen and Lang Dry Dock Company, of Hoboken, N.J., and of the Seattle Construction and Dry Dock Company, of Seattle, Wash., he incorporated the Todd Shipyards Corporation. To-day it is playing a prominent part in the development and expansion of the American merchant marine.

Miscellanea

The Mercury Shortage.—Chile is exploring its possible sources of mercury and, according to reports, may have as much as 3 to 4 tons of quicksilver a month to sell as from October next.

Metal into Textiles.—Beryllium, which is being used increasingly for hardening copper and which has various minor uses, has recently been proposed as an ingredient of a new textile fibre of the rayon group. The other principal raw material is seaweed.

U.S. Asbestos Industry.—Sales of United States asbestos attained a new record last year at 20,060 short tons, an increase of 30 per cent. over 1939, which was a record year, according to the Bureau of Mines. The value was 32 per cent. greater than in 1939.

Chromite.—The production of chromite in Turkey, which amounted to 3400 tons in 1924, rose to 208,305 tons in 1938, according to figures recently released. The output came mainly from the Guleman mines (Ergani Maden), which are said to be the most extensive chromite deposits in the world.

Tinplate Plant.—The Ministry of Supply has appointed a committee to report on the application to the tinplate industry of the policy of concentration of industry, having regard to redundant plant. Mr. J. C. Carr (Raw Materials Department, Ministry of Supply, Castle, Warwick) is the secretary.

The Need for Bricks.—An Advisory Committee has been set up by the Minister of Works to advise on steps to be taken to secure an adequate output of bricks, maximum co-ordination, pooling of resources and information, economy of manufacture and introduction of more scientific methods.

Helium for Britain.—The U.S. Secretary of the Interior has authorised Britain to take over 500,000 cubic feet of helium gas which had originally been sold to France for research and medical purposes. The gas will now be used in the United States in connection with British industrial contracts.

Gold Mining in S.A.—The tonnage of ore milled during 1940 by the mines of the Witwatersrand area and its extensions was 64,515,350—an increase of 6,175,150 tons compared with the total for the previous year and almost double what it was ten years ago. The output of gold by those mines was 13,683,418 oz. fine, an increase of 1,188,307 oz.

Mercury Statistics.—According to a final report issued by the Bureau of Mines, last year's U.S. mercury output was 37,777 flasks, more than double that of 1939. The number of mines in production was 159, or 52 more than in 1939. During the current year quicksilver production is expected to reach 40,000 flasks. Exports in 1940 aggregated 9617 flasks, of which 5178 came to the United Kingdom, other large buyers being Japan with 1598 flasks, Canada 775, and Australia 666. Exploration for further mercury deposits is being carried out by the Consolidated Mining and Smelting Company of Canada, Ltd., in the Pinchi Lake District, B.C.

Wellit Insulation.—Under this name a Swedish inventor has introduced a material in board or slab form, manufactured from a kraft paper and rendered impermeable to moisture by impregnation. The material is said to compare favourably with cork as regards insulation capacity, and it is much cheaper. It is being produced on an industrial scale in Stockholm.

Molybdenum from Sweden.—An important deposit of molybdenum in Sweden was discovered recently in Algruvan. The Government Testing Institute at Stockholm reports that the ore has a molybdenum sulphide content of 4·8 per cent. Arrangements have been made to install machinery and mining operations are expected to begin soon.

Canadian Mineral Production.—Mineral production in Canada last year jumped to £120 millions, according to the Dominion Department of Mines and Resources. The value of the 1940 production of the precious metals was in excess of £44·5 millions, compared with nearly £41 millions in 1939. Base-metal production figures cannot be disclosed, but the outputs of copper, nickel, lead, and zinc were greater than in 1939.

Low Grade Nickel Ores.—The Japan Nickel Company has developed a method of refining nickel from a serpentine rock of wide occurrence in Japan, which usually contains only 0·3 per cent. of nickel, 6·7 per cent. of magnesite, and small quantities of chromium. Details of the treatment are scanty, but the final product may be a ferro-nickel containing 20 per cent. of nickel, which can be directly used in the manufacture of alloy steels. A plant for the operation of the process has been erected.

Spain's Pyrites.—The Spanish Ministry of Industry has issued a decree requiring those concerned to exploit the country's pyrites resources in the national interests. Spanish sulphuric acid works must themselves roast copper pyrites with a copper content of 0·75 to 2 per cent., and sulphuric acid makers who do not themselves produce copper sulphate must supply copper sulphate works with the necessary copper. Four months is all that will be allowed under the decree for the installation of the needed plant.

Reconditioning Electricity Meters.—In view of the difficulty of obtaining supplies of replacement jewels and, to a lesser extent, pivots, for the reconditioning of electricity meters, the Electricity Commissioners asked its Meter Technical Committee to review the problem of utilising to the best advantage old meter jewels and pivots. A memorandum embodying the conclusions of the Meter Technical Committee has now been sent to the principal associations of the electricity supply industry. The Commissioners have decided not to circulate the memorandum to all electricity undertakers in view of the limited porportion who are likely to have both the appropriate apparatus and the trained staff for dealing with the matter.

Timber from the Far East.—The lumber industry in the Philippines, which is of primary importance to the inhabitants of the islands, to the Government, and to labour, is receiving the special attention of the authorities. In a recent publication it was stated that the Philippines are 60 per cent. covered with regal hardwood forests of commercial value. The timber industry in the islands is in a bad way, although more than 30 million pesos is invested in Philippine lumber, of which nearly half is American capital. The Government spends only half of what it collects from the industry on forestry administration. A good deal of confusion arises from duplicated nomenclature. Public statistical records that have been investigated have proved that timber imported to Hong Kong from Singapore was grown in Borneo and that when the timber reached Singapore it became known by a name different from that used in Borneo. This led to further inquiries and it was discovered that the same type of timber was being exported from different parts of South-East Asia, and that in these different countries which used different languages, the same timber had different names.

Personal and Business

Mr. J. G. Weir has resigned his post as Director-General of Mechanical Equipment, Ministry of Supply.

Mr. D. M. Evans Bevan has been appointed a director of the London Midland and Scottish Railway Company.

Sir Bernard D. F. Docker has been elected chairman of James Booth and Co. (1915), Ltd., and Sir Patrick Hannon has been elected a director.

The Minister of Works has appointed Mr. T. P. Bennett, F.R.I.B.A., to be Director of Works, in succession to the late Lieut.-Colonel C. L. Howard Humphreys.

Mr. W. M. Selvey has been unanimously elected, and has agreed to accept the office of President of the Institute of Fuel in succession to Lt.-Col. Sir John Greenly, as from October next.

Sir David Milne-Watson, Bart., has been nominated as President of the Fuel Luncheon Club for the coming session, in succession to Lt.-Col. W. A. Bristow, who has occupied the chair for the past two years.

Dr. H. L. Guy, F.R.S., has resigned his office of chief engineer of the mechanical department of Metropolitan-Vickers Electrical Company, Ltd., and his directorship of Metropolitan-Vickers Export Company, Ltd.

The trustees of the late Mr. C. Peter Sandberg, M. Inst. C.E., have arranged to carry on the business of Messrs. Sandberg under the management of Mr. A. J. W. Graham, M.I. Mech. E., with the assistance of Mr. J. F. Sandberg.

Dr. A. H. Railing and Mr. Leslie Gamage have been appointed general managers of the General Electric Company, Ltd. Each has been a director for many years. Dr. Railing has devoted his attention chiefly to the engineering and manufacturing sides, while Mr. Gamage, in addition to occupying the position of secretary, has been director in charge of overseas business.